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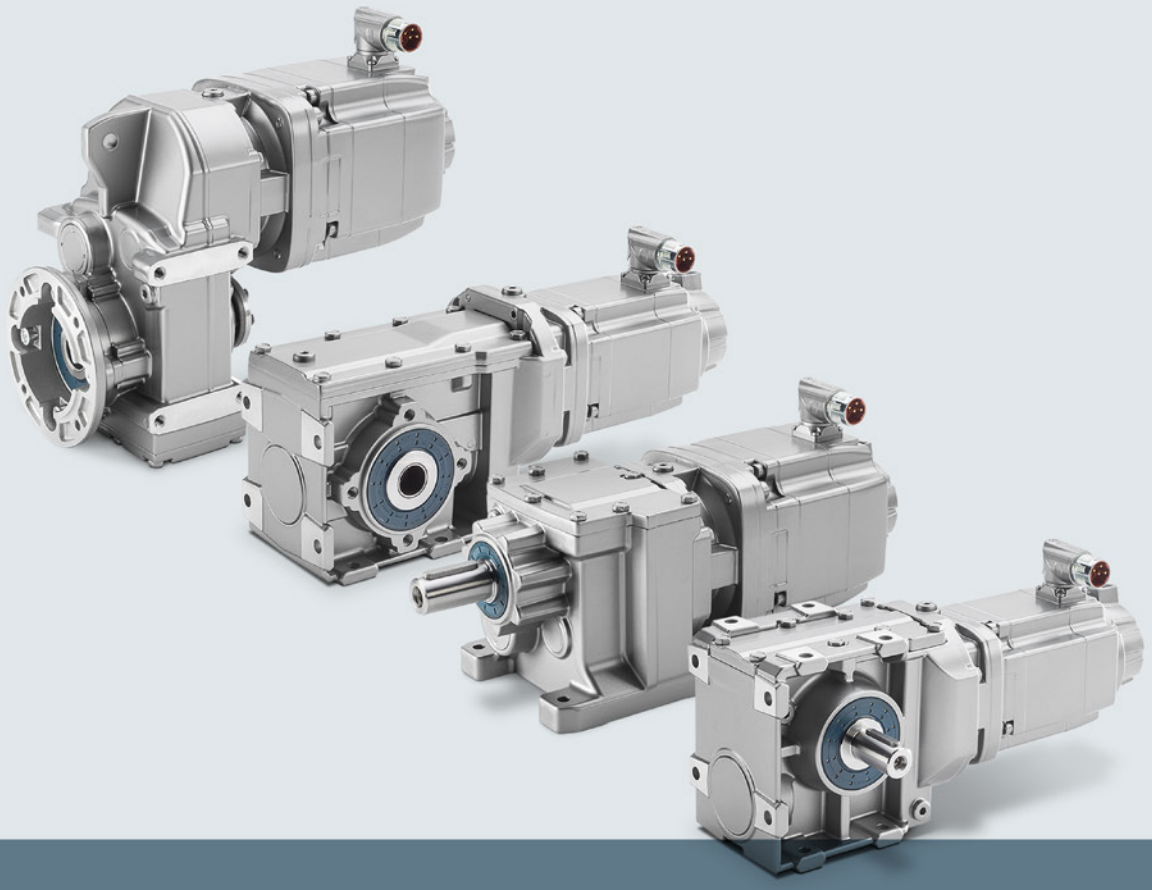

SIMOTICS

SIMOTICS S-1FG1 servo geared motors

Helical geared motors, parallel shaft geared motors, bevel geared motors, and helical worm geared motors

Operating Instructions

Edition 11/2015

Answers for industry.

SIEMENS

SIMOTICS

Drive technology SIMOTICS S-1FG1 servo geared motor

Operating Instructions

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

This documentation should be kept in a location where it can be easily accessed and made available to the personnel responsible.

Target group

These operating instructions are intended for electricians, fitters, service technicians and warehouse personnel.

These Operating Instructions apply for the SIMOTICS S-1FG1 servo geared motors, referred to below as "1FG1".

These Operating Instructions explain how to handle the 1FG1 from delivery to disposal.

Before you start using the motor, you must read these Operating Instructions to ensure safe, problem-free operation and to maximize the service life.

Siemens strives continually to improve the quality of information provided in these Operating Instructions.

- If you find any mistakes or would like to offer suggestions about how this document could be improved, contact the Siemens Service Center.
- Always follow the safety instructions and notices in this Product Information.

The warning notice system is explained on the rear of the inside front.

Text features

In addition to the notes that you must observe for your own personal safety as well as to avoid material damage, in this document you will find the following text features:

Operating instructions

Operating instructions with the specified sequence are designated using the following symbols:

The arrow indicates the start of the operating instructions.

The individual handling steps are numbered.

1. Execute the operating instructions in the specified sequence.

The square indicates the end of the operating instruction.

Operating instructions without a specified sequence are identified using a bullet point:

- Execute the operating instructions.

Enumerations

- Enumerations are identified by a bullet point without any additional symbols.
  - Enumerations at the second level are hyphenated.

Notes

Notes are shown as follows:

Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

More information

Information on the following topics is available under the link:

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

More information (https://support.industry.siemens.com/cs/de/en/view/108998034)

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Note

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EC Declaration of Conformity

The EC Declaration of Conformity for the Low Voltage Directive can be found in the Appendix.

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Fundamental safety instructions

1

1.1 General safety instructions

⚠ DANGER

Danger to life due to live parts and other energy sources

Death or serious injury can result when live parts are touched.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, six steps apply when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the supply.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.
   - Check whether the existing auxiliary supply circuits are de-energized.
   - Ensure that the motors cannot move.
3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water.
4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
5. Secure the energy sources against switching on again.
6. Ensure that the correct machine is completely interlocked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠ WARNING

Danger to life through a hazardous voltage when connecting an unsuitable power supply

Touching live components can result in death or severe injury.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV-(Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

⚠ WARNING

Danger to life when live parts are touched on damaged motors/devices

Improper handling of motors/devices can damage them.

For damaged motors/devices, hazardous voltages can be present at the enclosure or at exposed components.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged motors/devices.

⚠ WARNING

Danger to life through electric shock due to unconnected cable shields

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

⚠ WARNING

Danger to life due to electric shock when not grounded

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

⚠ WARNING

Danger to life due to electric shock when opening plug connections in operation

When opening plug connections in operation, arcs can result in severe injury or death.

- Only open plug connections when the equipment is in a no-voltage state, unless it has been explicitly stated that they can be opened in operation.

⚠ WARNING

Danger to life through unexpected movement of machines when using mobile wireless devices or mobile phones

Using mobile wireless devices or mobile phones with a transmit power > 1 W closer than approx. 2 m to the components may cause the devices to malfunction, influence the functional safety of machines therefore putting people at risk or causing material damage.

- Switch the wireless devices or mobile phones off in the immediate vicinity of the components.

⚠ WARNING

Danger of an accident occurring due to missing or illegible warning labels

Missing or illegible warning labels can result in accidents involving death or serious injury.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, in the national language if necessary.
- Replace illegible warning labels.

⚠ WARNING

Danger to life when safety functions are inactive

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important safety notices for Safety Integrated functions

If you want to use Safety Integrated functions, you must observe the safety notices in the Safety Integrated manuals.

WARNING

Danger to life from electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment such as transformers, converters or motors.

People with pacemakers or implants are at a special risk in the immediate vicinity of these devices/systems.

- Ensure that the persons involved are the necessary distance away (minimum 2 m).

WARNING

Danger to life from permanent magnet fields

Even when switched off, electric motors with permanent magnets represent a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.

- If you are such a person (with heart pacemaker or implant) then keep a minimum distance of 2 m.
- When transporting or storing permanent magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.

WARNING

Injury caused by moving parts or those that are flung out

Touching moving motor parts or drive output elements and loose motor parts that are flung out (e.g. feather keys) in operation can result in severe injury or death.

- Remove any loose parts or secure them so that they cannot be flung out.
- Do not touch any moving parts.
- Safeguard all moving parts using the appropriate safety guards.

WARNING

Danger to life due to fire if overheating occurs because of insufficient cooling

Inadequate cooling can cause overheating resulting in death or severe injury as a result of smoke and fire. This can also result in increased failures and reduced service lives of motors.

- Comply with the specified coolant requirements for the motor.

⚠ WARNING

Danger to life due to fire as a result of overheating caused by incorrect operation

When incorrectly operated and in the case of a fault, the motor can overheat resulting in fire and smoke. This can result in severe injury or death. Further, excessively high temperatures destroy motor components and result in increased failures as well as shorter service lives of motors.

- Operate the motor according to the relevant specifications.
- Only operate the motors in conjunction with effective temperature monitoring.
- Immediately switch off the motor if excessively high temperatures occur.

⚠ CAUTION

Risk of injury due to touching hot surfaces

In operation, the motor can reach high temperatures, which can cause burns if touched.

- Mount the motor so that it is not accessible in operation.

When maintenance is required

- allow the motor to cool down before starting any work.
- Use the appropriate personnel protection equipment, e.g. gloves.

1.2 Handling electrostatic sensitive devices (ESD)

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

NOTICE

Damage through electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g conductive foam rubber of aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

1.3 Industrial security

Note

Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. For more information about industrial security, visit this address (http://www.siemens.com/industrialsecurity).

To stay informed about product updates as they occur, sign up for a product-specific newsletter. For more information, visit this address (http://support.automation.siemens.com).

WARNING

Danger as a result of unsafe operating states resulting from software manipulation

Software manipulation (e.g. by viruses, Trojan horses, malware, worms) can cause unsafe operating states to develop in your installation which can result in death, severe injuries and/or material damage.

- Keep the software up to date.

  You will find relevant information and newsletters at this address (http://support.automation.siemens.com).
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.

  You will find further information at this address (http://www.siemens.com/industrialsecurity).
- Make sure that you include all installed products into the holistic industrial security concept.

1.4 Residual risks when operating geared motors

The geared motors may be operated only if all protective equipment is used.

Geared motors may be handled only by qualified and instructed qualified personnel that knows and observes all safety instructions for the geared motors that are explained in the associated technical user documentation.

When assessing the machine's risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
   - Response times of the control system and of the drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - Errors during the assembly, installation, programming and parameterization
   - Use of wireless devices/mobile phones in the immediate vicinity of the control system
   - External influences/damage
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the geared motor under fault conditions caused by, for example:
   - Component failure
   - Software errors in converter operation
   - Operation and/or environmental conditions outside the specification
   - External influences/damage
3. Hazardous shock voltages caused by, for example,
   - Component failure
   - Influence during electrostatic charging
   - Induction of voltages in moving geared motors
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of noxious substances and emissions in the case of improper operation and/or improper disposal of components

Description

2

Overview

The SIMOTICS S-1FG1 servo geared motor, referred to below as 1FG1, forms a single system comprising a mechanical gearbox and a compact, permanent-magnet synchronous motor. The available options, gearbox variants and encoders, together with the expanded product range, mean that the 1FG1 servo geared motors can be optimally adapted to any application. They therefore also satisfy the permanently increasing demands of state-of-the-art machine generations.

The servo geared motor can be combined with the SINAMICS S120 drive system to create a high-performance system with a high degree of functionality. The integrated encoder systems for speed and position control can be selected depending on the application.

The servo geared motors are designed for operation without external cooling and the heat is dissipated through the motor surface. The 1FG1 servo geared motors have a high overload capability.

2.1 Correct usage

⚠ WARNING

Danger to life and material damage when incorrectly used

If you do not use the motors correctly, there is a risk of death, severe injury and/or material damage.

- Only use the motors in accordance with their correct usage.
- Make sure that the conditions at the location of use comply with all the rating plate data.
- Make sure that the conditions at the location of use comply with the conditions specified in this documentation. When necessary, take into account deviations regarding approvals or country-specific regulations.

If you wish to use special versions and design variants whose specifications vary from the motors described in this document, then contact your local Siemens office.

If you have any questions regarding the intended usage, please contact your local Siemens office.

The 1FG1 is prescribed for deployment in industrial or business plants.

The 1FG1 is not permitted to be operated in hazardous areas.

Any other application of the 1FG1 is considered to be incorrect usage.

Compliance with all of the specifications in the Operating Instructions is part of correct usage.

Note

The performance data assumes an ambient temperature of -15 °C to +40 °C and an installation altitude of up to 1 000 m above sea level.

In the case of other ambient temperatures and installation altitudes, please contact Technical Support.

Conditions at the location of use must comply with the specifications on the rating plate.

Note

Operate the 1FG1 within the specified power range.

Deviating operating conditions must be contractually agreed.

The 1FG1 is only approved for operation through a converter.

The 1FG1 is designed for operation in sheltered areas under normal climatic conditions, such as those found on shop floors.

Note

All changes to the 1FG1 and its operating conditions require agreement with, and the approval of, the competent Siemens regional office.

Application

The 1FG1 servo geared motors described in these Operating Instructions have been designed for stationary use in general engineering applications.

2.2 Technical features and ambient conditions

2.2.1 Regulations

The motors comply with the following regulations according to IEC / EN 60034:

Table 2- 1 Regulations that have been applied

Feature	Standard
Ratings and operating performance	IEC/EN 60034-1
Degree of protection [1)]	IEC/EN 60034-5
Type of construction [(1)]	IEC/EN 60034-7
Terminal markings	IEC/EN 60034-8
Noise emission	IEC/EN 60034-9
Temperature monitoring	IEC/EN 60034-11
Vibration severity levels	IEC/EN 60034-14

[(1)] The degree of protection and type of construction of the motor are stamped on its rating plate.

The servo geared motors comply with the relevant sections of EN 60034 and EN 60204-1. The servo geared motors comply with the 2006/95/EC Low Voltage Directive. Motors which have "UR" stamped on their rating plates comply with UL regulations.

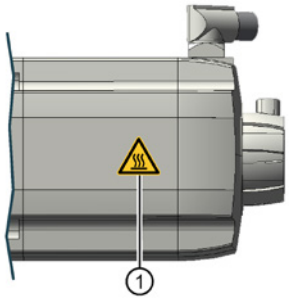
Servo geared motors are components designed for installation in machines in accordance with the Machinery Directive. They must not be commissioned until it has been verified that the end product complies with this directive (also take into account EN 60204-1).

Note

Make sure that your end product is in compliance with all of the applicable laws! The applicable domestic, local, and system-specific regulations and requirements must be taken into account.

2.2.2 Warning labels on the servo geared motor

The following warning labels are attached to the motor



1 "Hot surfaces" warning sign. The warning sign is on all four sides of the housing.

2.2.3 Technical features of the motor

Motor type	Permanent-magnet synchronous motor	
Magnet material	Rare-earth magnetic material	
Cooling	Natural cooling	
Weight	See rating plate	
Noise emission (sound pressure level) according to EN 60034-9 (IEC 60034-9) up to rated speed (tolerance +3 dB)	1FG1 SH 36 to 48 1FG1 SH 63 1FG1 SH 80 to 100	60 dB(A) 70 dB(A) 75 dB(A)
Insulation of the stator winding according to EN 60034-1 (IEC 60034-1)	Temperature class 155 (F) for a winding temperature of ΔT = 100 K at an ambient temperature of +40 °C	
Installation altitude according to EN 60034-1 (IEC 60034-1)	≤ 1000 m above sea level, otherwise power derating	
Degree of protection according to EN 60034-5 (IEC 60034-5) [1]	IP65 The degree of protection only refers to the motor. When selecting higher degrees of protection, take the equipping on the gearbox side into account. Protect the shaft outlet on the gearbox from contamination/splashwater. Protection against water alone is not adequate for liquids that contain oil, can creep and/or are aggressive. In such cases, protect the servo geared motor with a suitable cover.	
Temperature monitoring	Temperature sensor in the stator winding	
Paint finish	Anthracite (RAL 7016)	
Built-in encoder systems for motors without DRIVE-CLiQ interface	• IC2048S/R incremental encoder sin/cos 1 Vpp, 2048 S/R [3] with C and D tracks • AM2048S/R absolute value encoder 2048 S/R [3], 4096 revolutions, multiturn, with EnDat interface • Resolver, multi-pole (number of pole pairs corresponds to number of pole pairs of the motor) • 2-pole resolver	
Integrated encoder systems for motors with DRIVE-CLiQ interface	• AS20DQI, 20-bit singleturn absolute encoder • AM20DQI absolute value encoder 20-bit + 12-bit multi-turn • R15DQ resolver 15-bit • R14DQ resolver 14-bit	
Connection	Connectors for signals and power, can be rotated	
Holding brake	• PE holding brake (standard and with increased holding torque) • Spring-loaded brake (holding brake with increased energy capability)	

S/R = signals/revolution

2.2.4 Properties of the gearboxes

The gearbox is supplied with two or three transmission stages.

The gearbox is suitable for various mounting positions.

NOTICE
Gearbox damage due to incorrect oil level In different mounting positions, an incorrect oil level can cause gearbox damage. • Maintain the correct oil level in the respective mounting positions.

Gearbox housing

Depending on size, the gearbox housings are made of die-cast aluminum or cast iron. See the table below

Table 2- 2 Housing material

Gearbox type	Size			
	29	39	49	from 59
Helical gearbox	Aluminum	Aluminum	Cast iron	Cast iron
Parallel shaft gearbox	Aluminum	Cast iron	Cast iron	Cast iron
Bevel gearbox B	Aluminum	Aluminum	Aluminum	Cast iron
Bevel gearbox K	Aluminum	Cast iron	Cast iron	Cast iron
Helical worm gearbox C	Aluminum	Cast iron	Cast iron	Cast iron

Geared components

The geared components are hardened and ground.

For the helical worm gearbox, the worm is hardened and ground. The gear is manufactured from high-quality bronze.

The bevel gear stage of the bevel gearbox is lapped in pairs.

Lubrication

The geared components are supplied with adequate lubricant by means of dip lubrication.

Shaft bearings

All shafts are mounted in roller bearings. The roller bearings are lubricated using splash lubrication or oil-spray lubrication. Bearings that are not supplied with lubricant are closed and grease-lubricated.

Shaft sealing rings

The shaft sealing rings on the output side prevent lubricant from escaping from the housing at the shaft outlet and prevent pollution from entering the housing.

The optimum use of the seals depends on the ambient conditions and the lubricant being used.

Radial shaft sealing ring

A high-quality radial shaft sealing ring is used as standard seal. The ring is provided with an additional dust lip to protect against contaminants from outside.

Sealing ring for a longer service life (optional)

The radial shaft sealing ring with dust lip has an additional buffer axial seal towards the inside of the gearbox. The buffer axial seal has a sinusoidal sealing lip that protects the sealing ring from contaminations.

Sealing ring to handle increased environmental stress (optional)

The sealing ring is equipped with an additional fiber disk. In addition to the longer service life, the disk also provides increased protection against higher environmental stress as a result of moisture and dust.

Noise

The geared motors are certified for a wide range of installation and operating conditions. Conditions such as rigid or vibration-isolated foundation design influence noise emission, sometimes significantly.

The circumferential velocity of the motor pinion has a significant influence on the additional gearbox noise. This is the reason that higher speeds or low transmission ratios result in higher noise.

Note

External noise

Noise not generated by the gearbox but emitted from it is not taken into consideration.

Noise emitted by the drive and driven machines or the base is not taken into consideration.

2.2.5 Mounting positions

NOTICE
Gearbox damage due to incorrect mounting position Incorrect mounting positions result in inadequate lubrication of gearboxes. Inadequate lubrication can cause gearbox damage. • Only operate the gearbox in the mounting position specified on the rating plate.

Note

Only gearboxes of size 29 are lubricated for life. These gearboxes have no openings for checking the oil level.

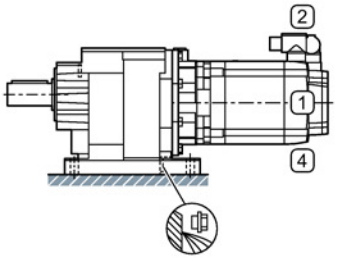
Mounting positions M2 and M4 are equipped with a vent valve.

C29 has a vent valve in all mounting positions.

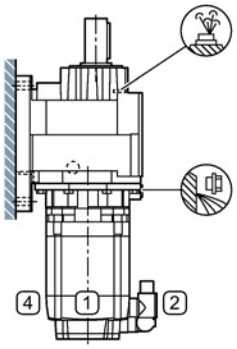
Symbol	Meaning
	Identifying marking of vent plug
	Identifying marking for ventilation, opposite side
	Identifying marking for oil level plug
	Identifying marking for oil level, opposite side
	Identifying marking for oil drain plug
	Identifying marking for oil drain, opposite side

Symbol	Meaning
A, B	Output side A, output side B
②	2-stage gearbox
③	3-stage gearbox
① ... ④	Position of the connection plug

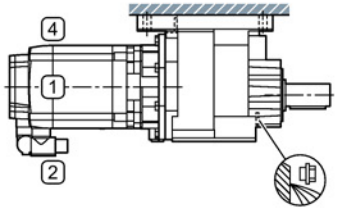
2.2.5.1 Two- and three-stage helical gearbox



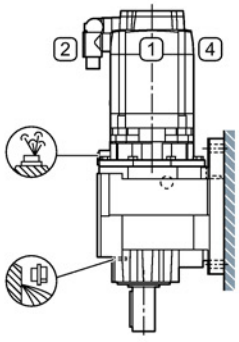
M1



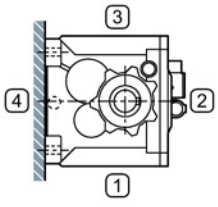
M2



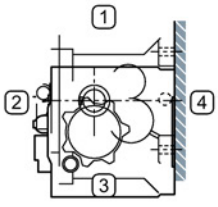
M3



M4



M5



M6

Image 2-1 Mounting positions for helical gearboxes Z and D, foot-mounted design, size 29, 2-stage and 3-stage

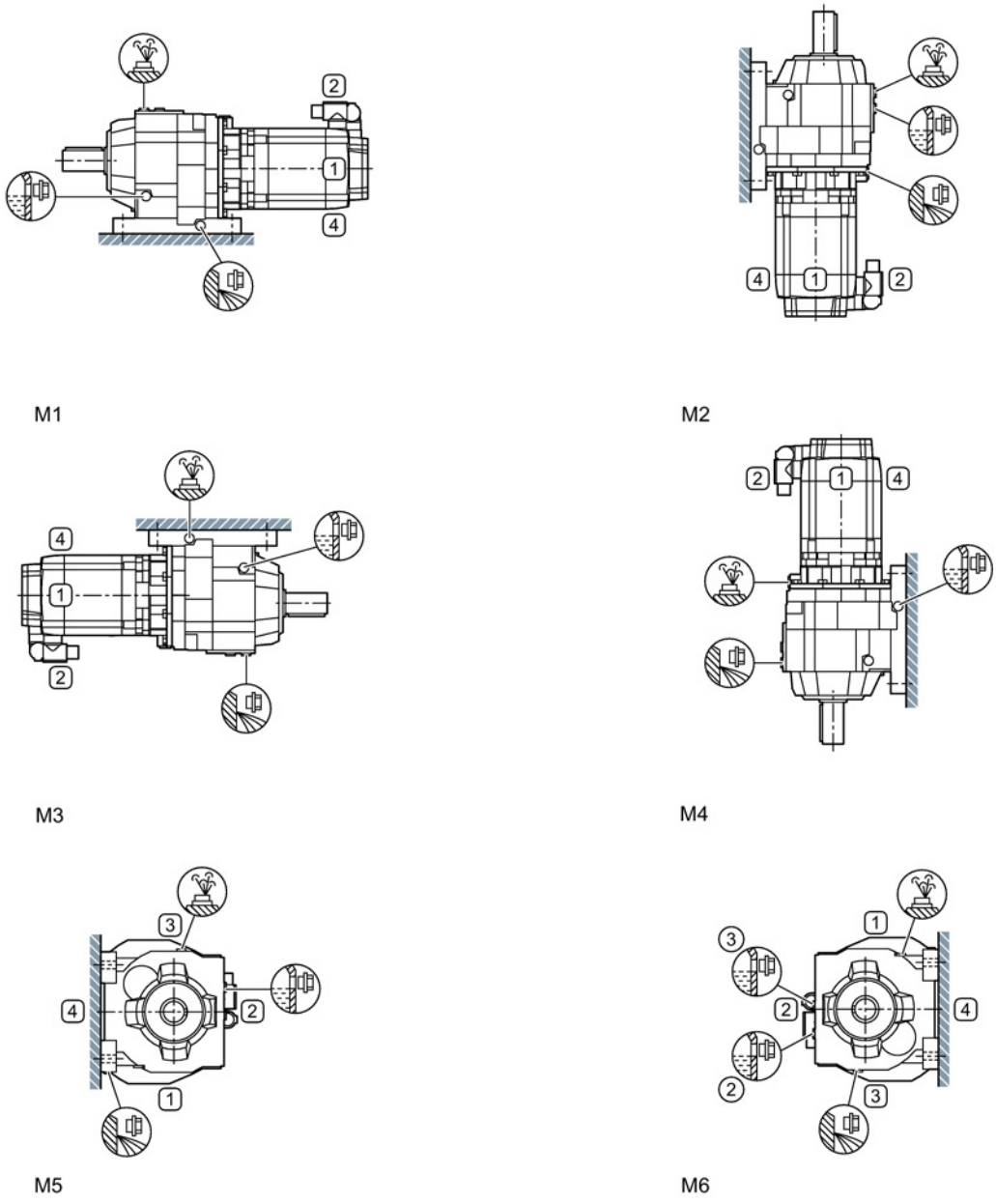
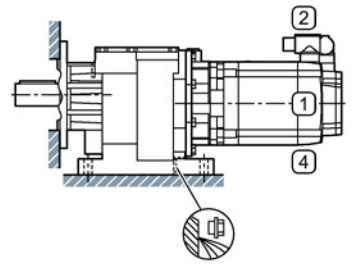
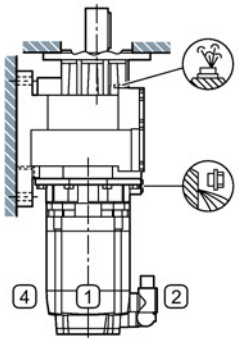


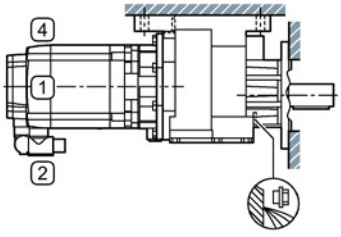
Image 2-2 Mounting positions for helical gearboxes Z and D, foot-mounted design, sizes 39 - 129, 2-stage and 3-stage



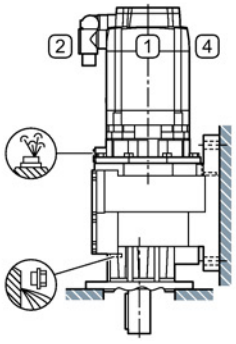
M1



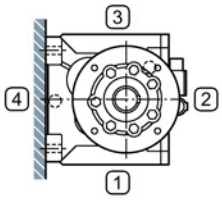
M2



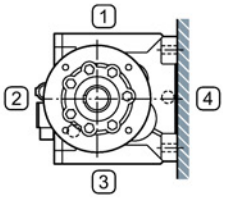
M3



M4



M5



M6

Image 2-3 Mounting positions for helical gearboxes ZB and DB, foot, flange-mounted design, size 29,
2-stage and 3-stage

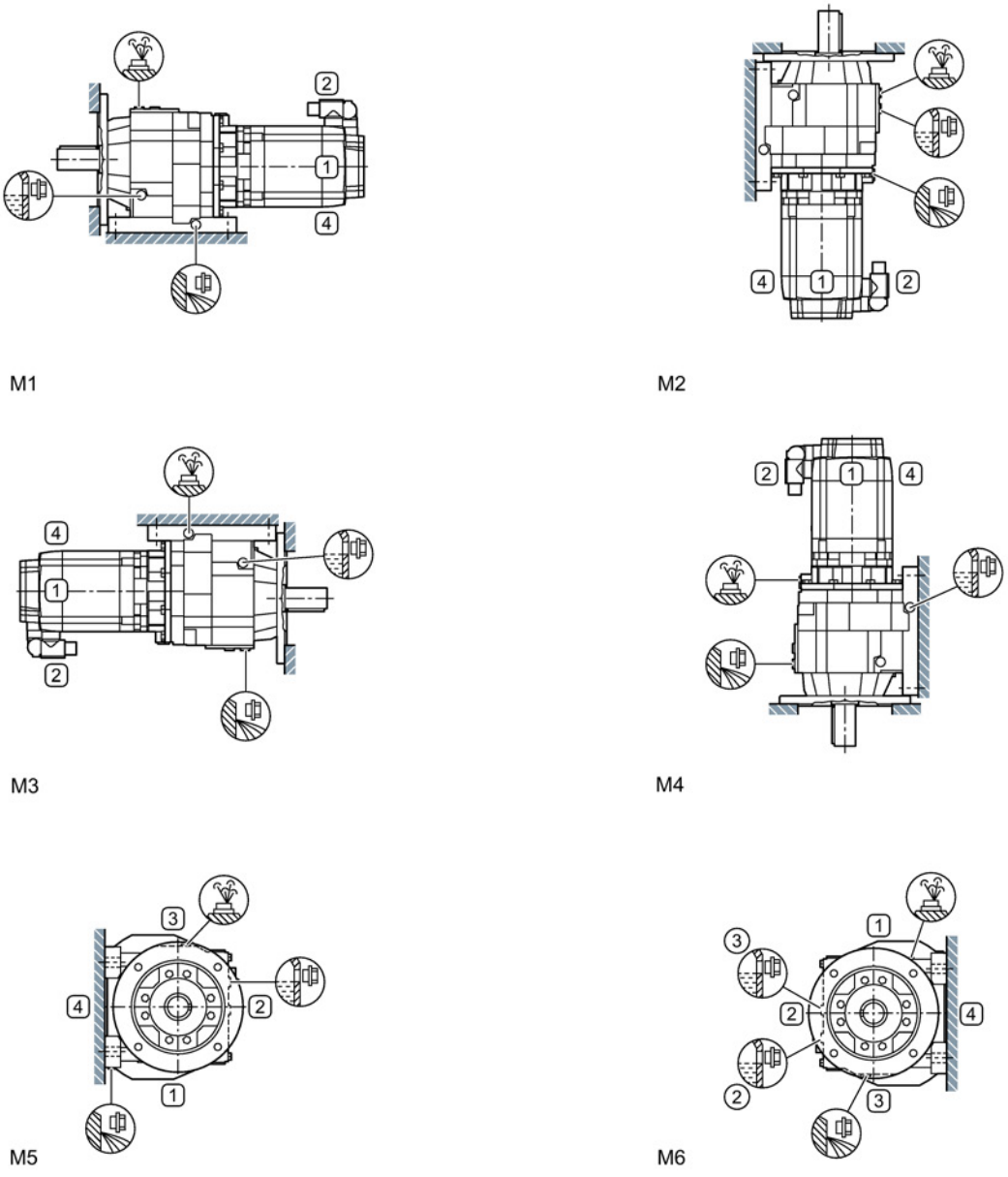
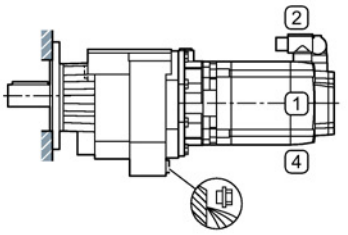
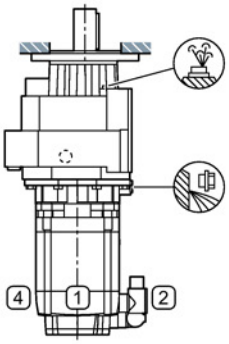


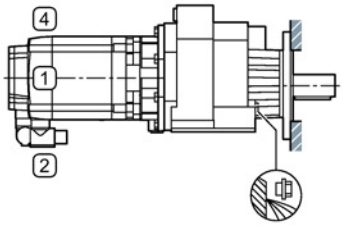
Image 2-4 Mounting positions for helical gearboxes ZB and DB, foot-, flange-mounted design, sizes 39 - 89, 2-stage and 3-stage



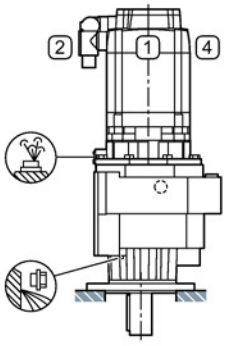
M1



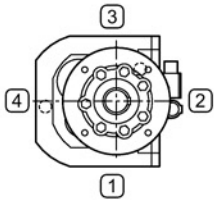
M2



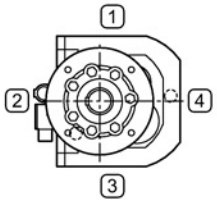
M3



M4



M5



M6

Image 2-5 Mounting positions for helical gearboxes DF and ZF (flange design), and DZ and ZZ (housing flange design), size 29, 2-stage and 3-stage

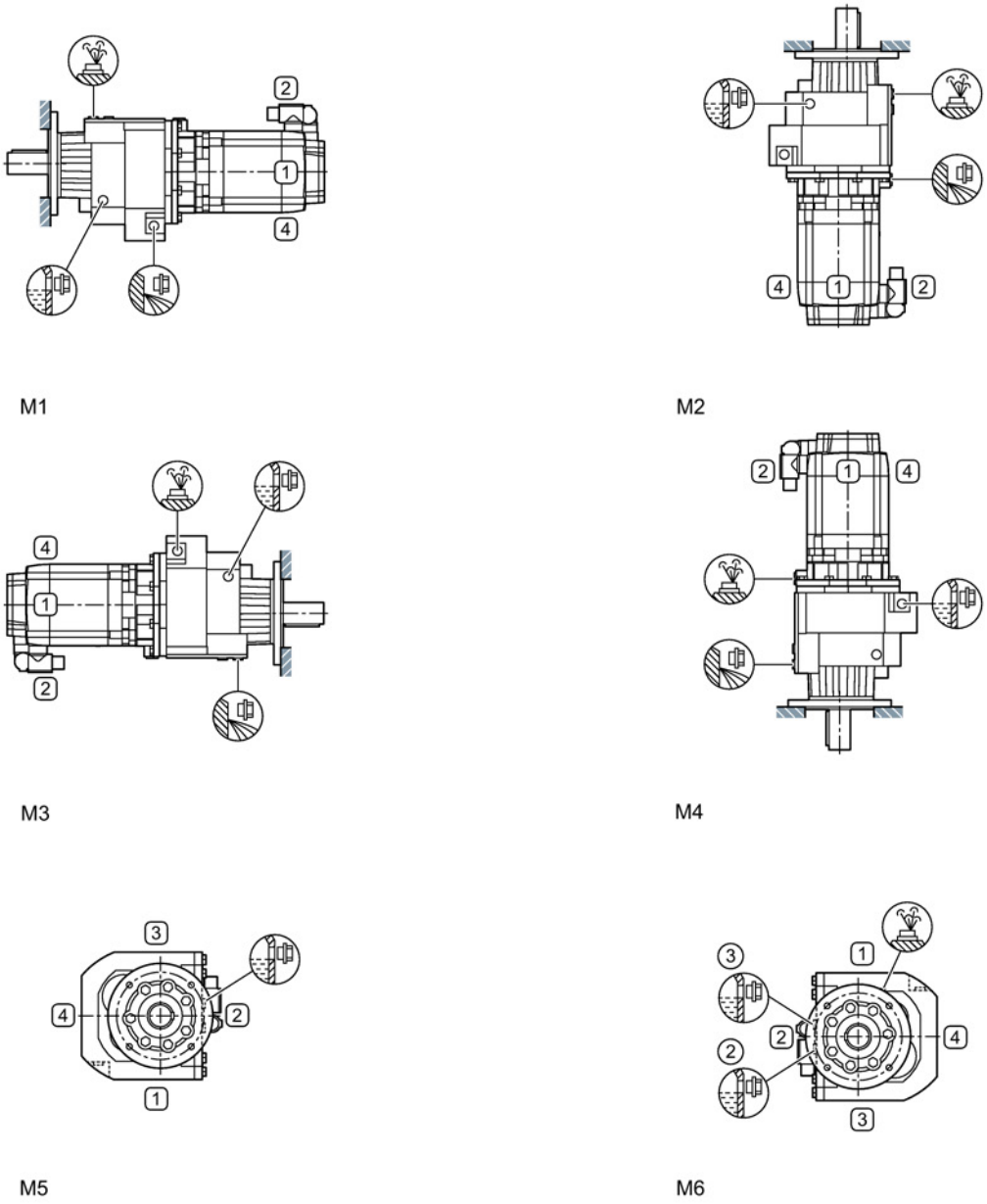


Image 2-6 Mounting positions for helical gearboxes DF and ZF (flange design), and DZ and ZZ (housing flange design), size 39, 2-stage and 3-stage

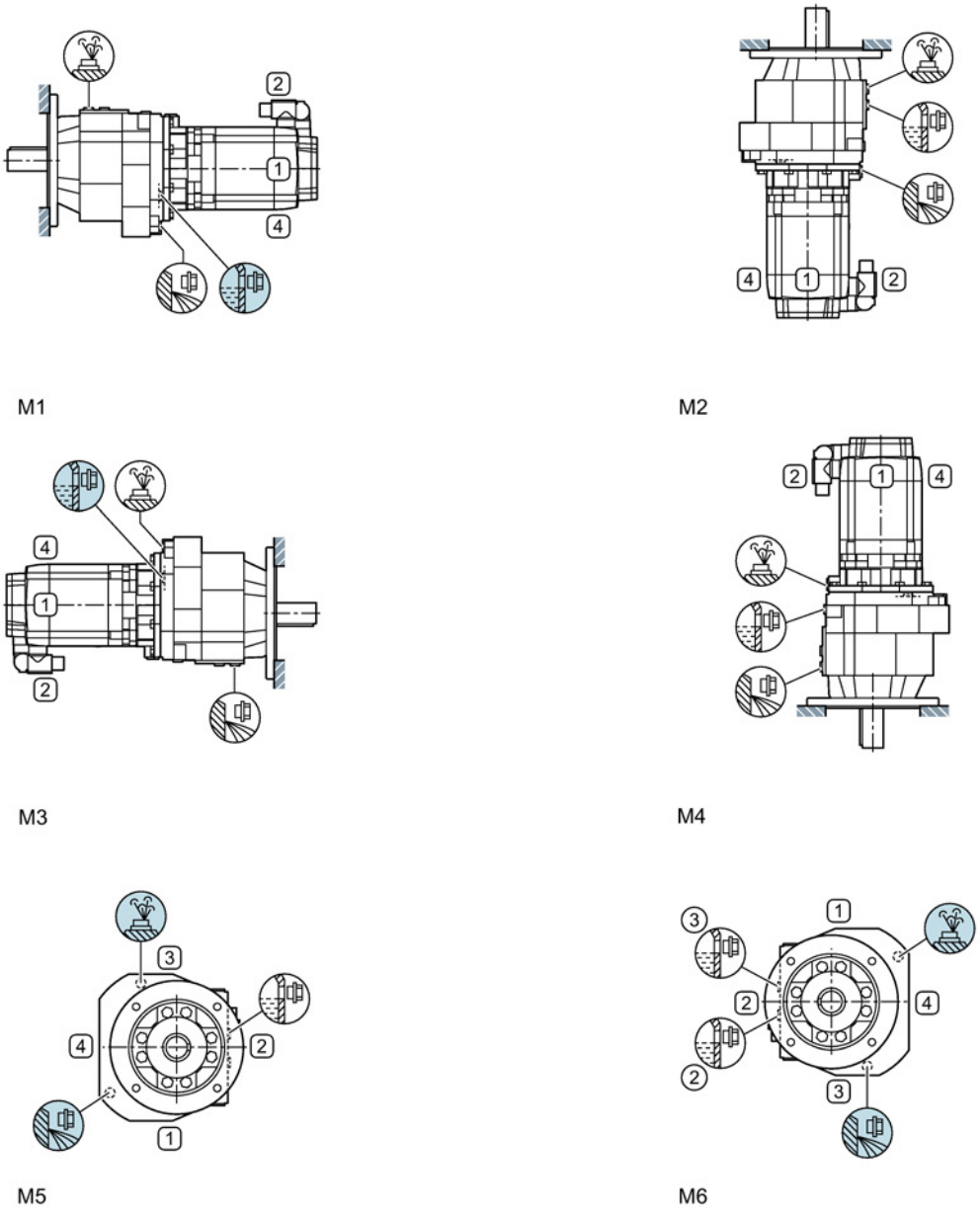


Image 2-7 Mounting positions for helical gearboxes DF and ZF (flange design), and DZ and ZZ (housing flange design), sizes 49 - 129, 2-stage and 3-stage

2.2.5.2 Parallel shaft gearbox

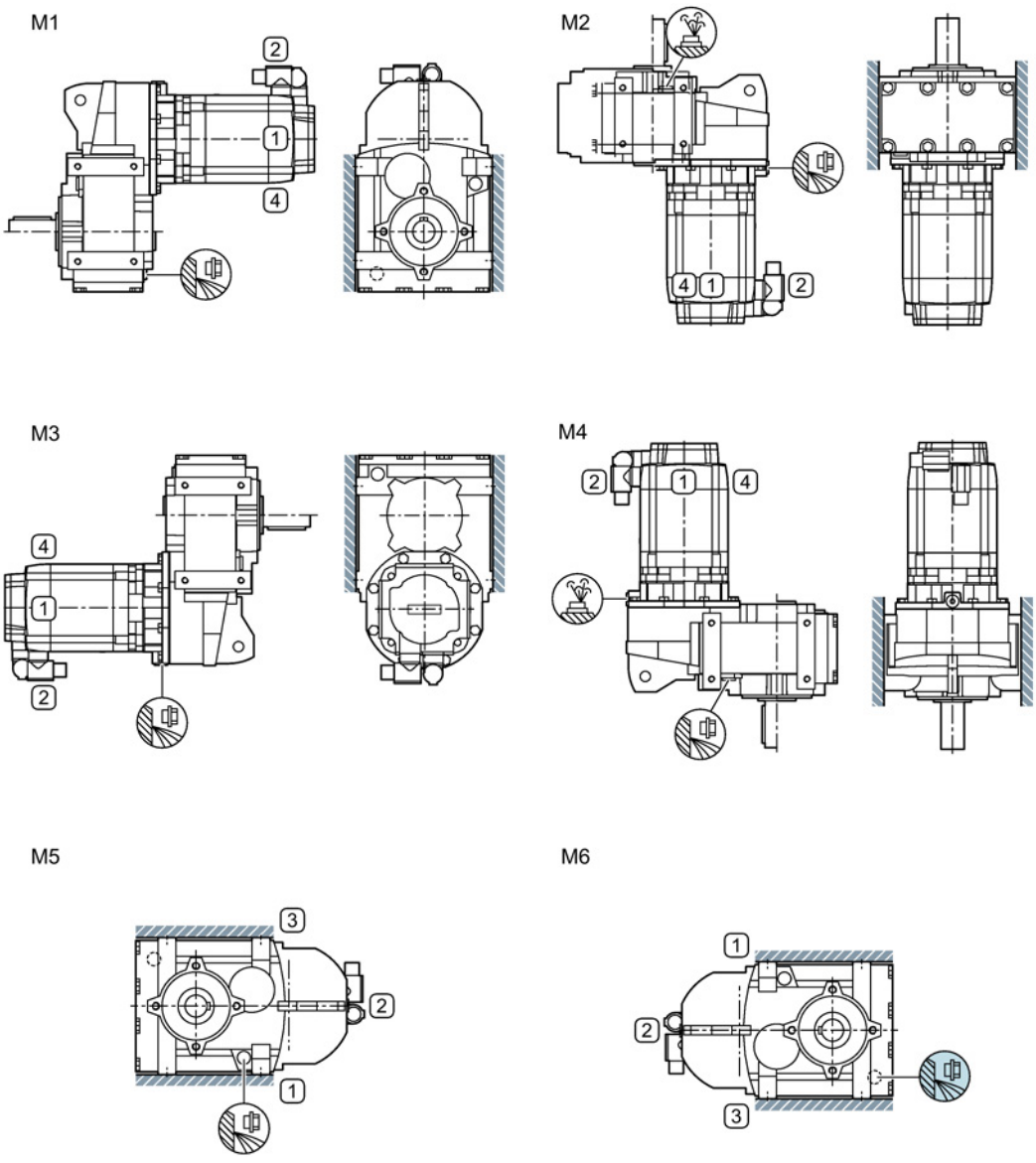


Image 2-8 Mounting positions for parallel shaft gearboxes FZ and FD, foot-mounted design, size 29,
2-stage and 3-stage

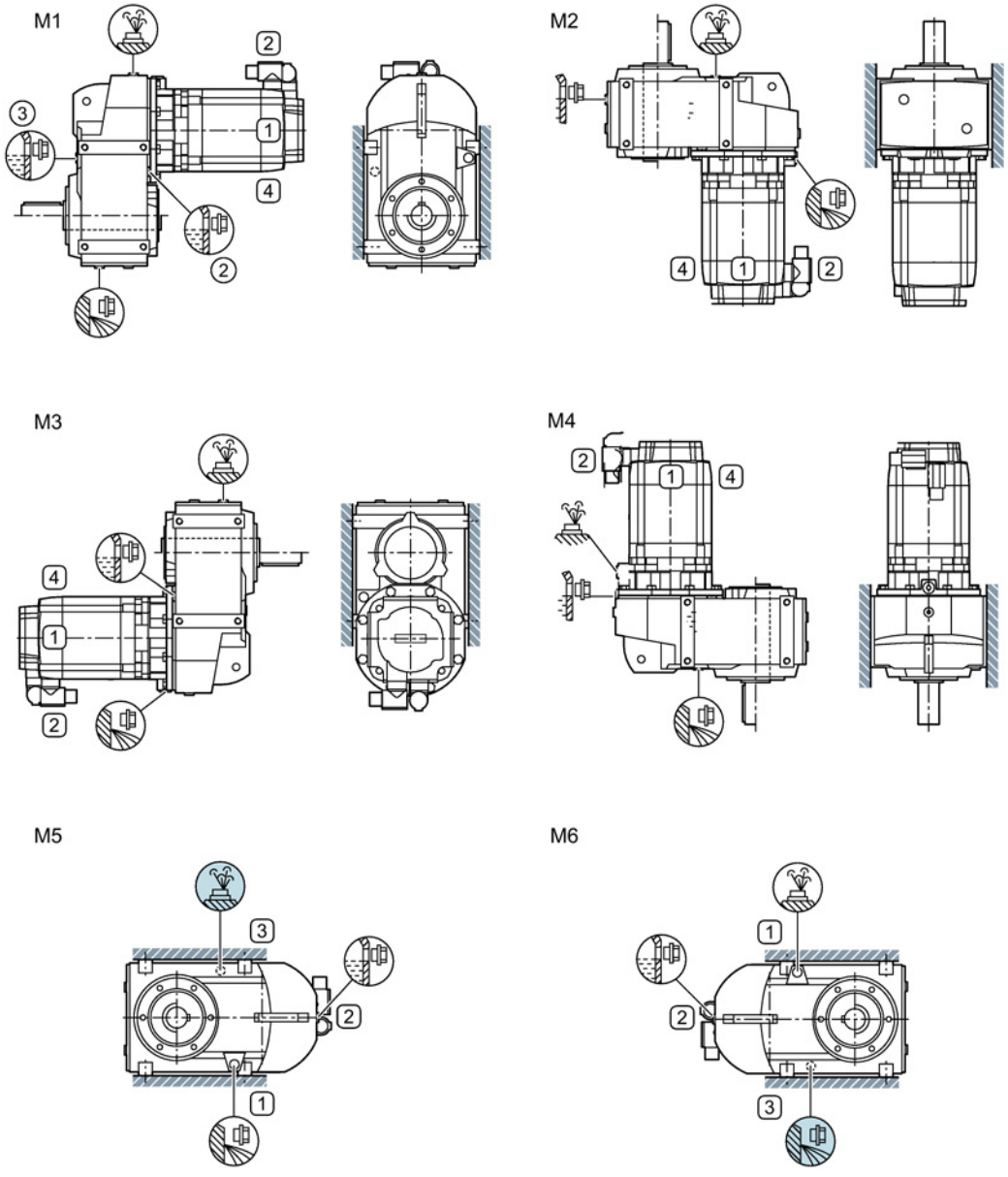


Image 2-9 Mounting positions for parallel shaft gearboxes FZ and FD, foot-mounted design, sizes 39 - 129,
2-stage and 3-stage

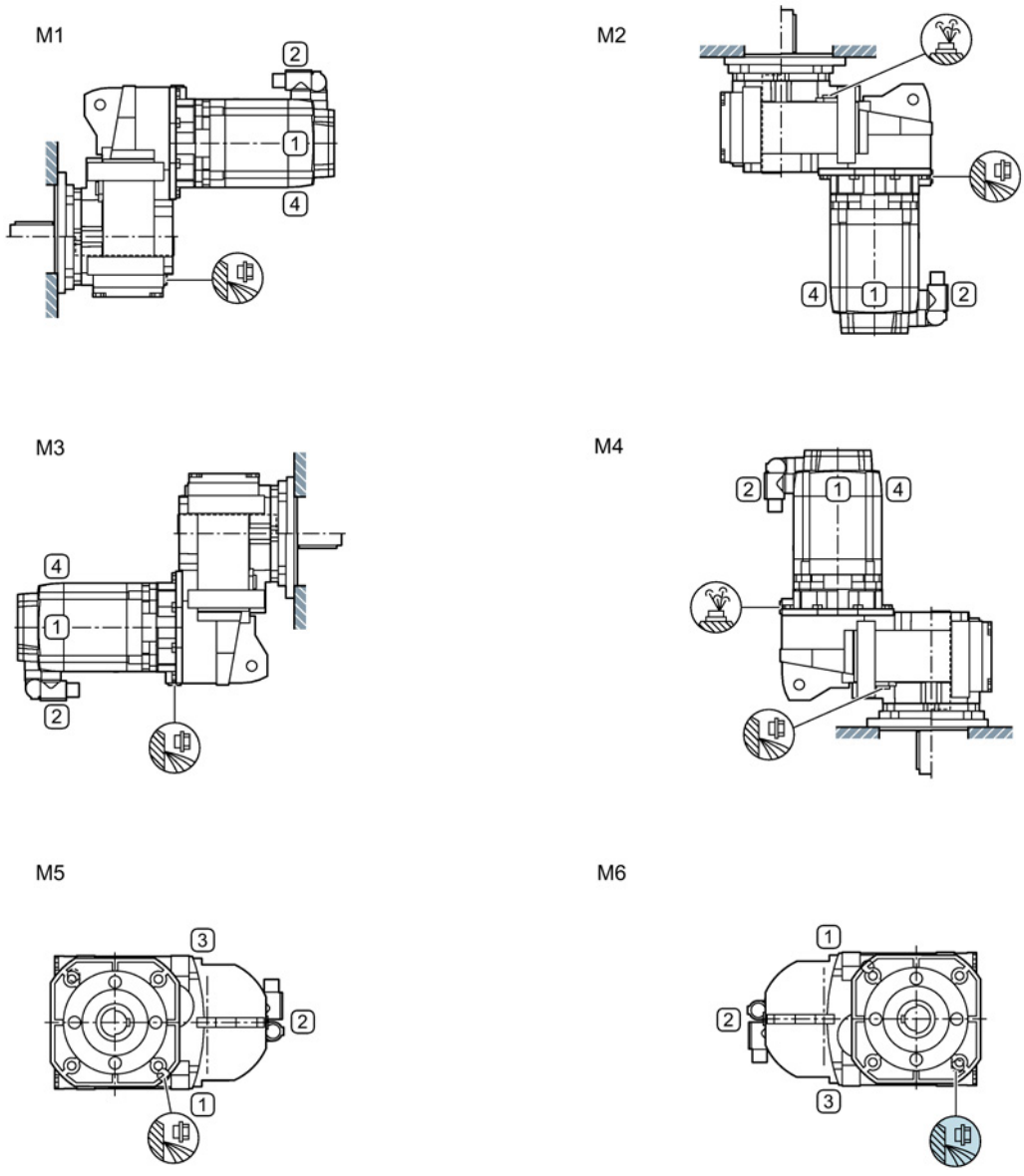


Image 2-10 Mounting positions for parallel shaft gearboxes FZ.F and FD.F (flange design), and FZ.Z and FD.Z, (housing flange design), size 29, 2-stage and 3-stage

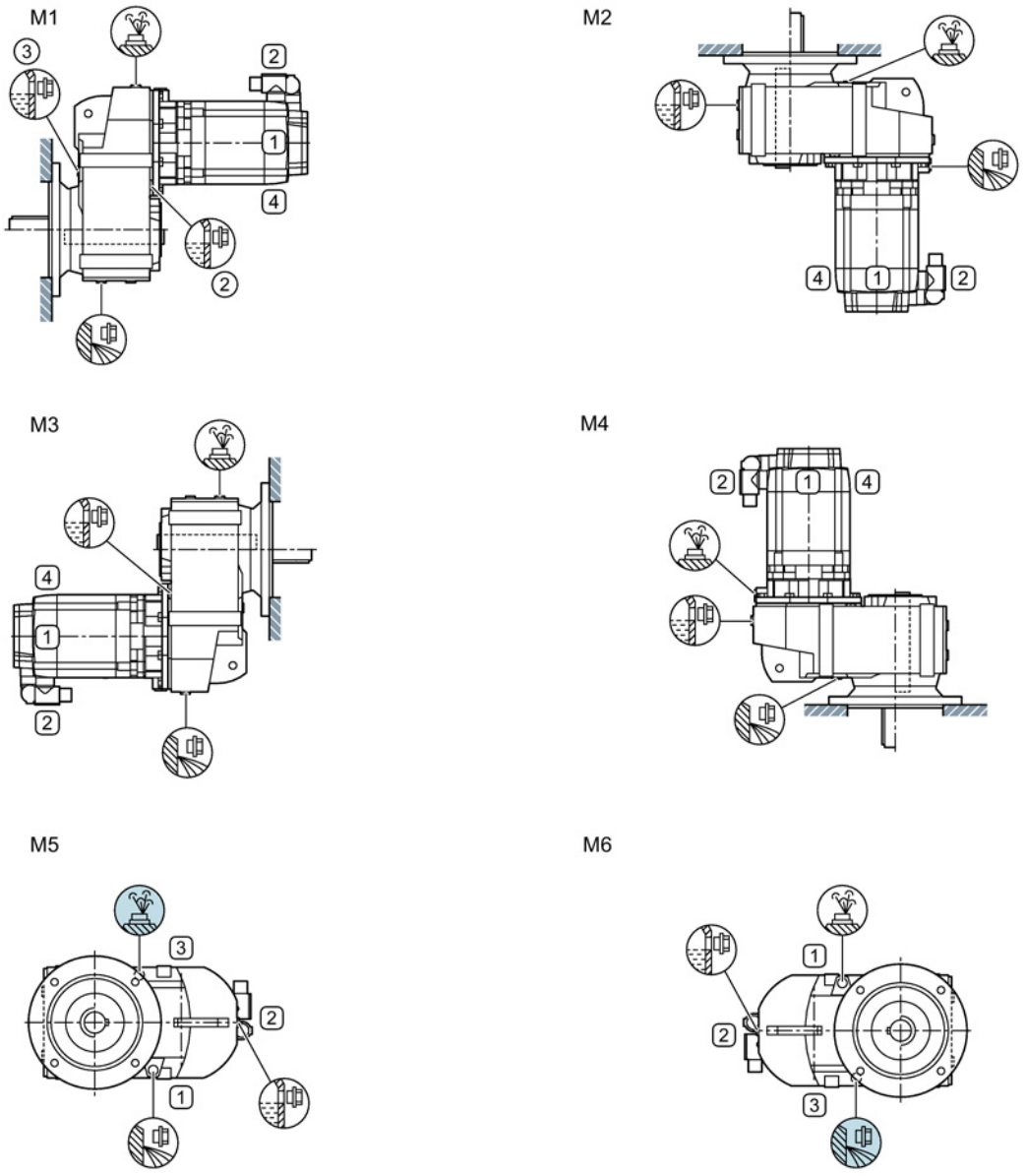


Image 2-11 Mounting positions for parallel shaft gearboxes FZ.F and FD.F (flange design), and FZ.Z and FD.Z, (housing flange design), sizes 39 - 129, 2-stage and 3-stage

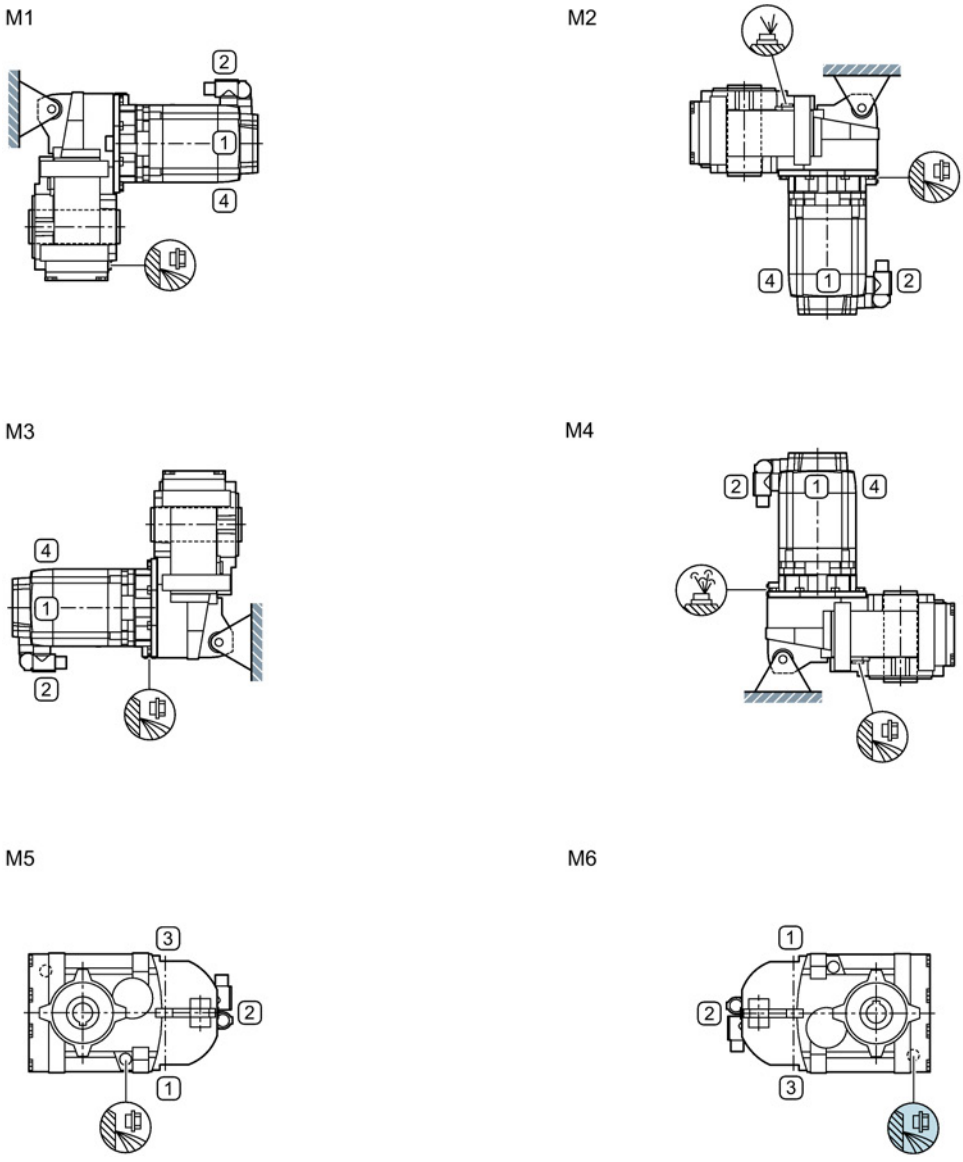


Image 2-12 Mounting positions for parallel shaft gearboxes FZAD and FDAD, shaft-mounted design, size 29, 2-stage and 3-stage

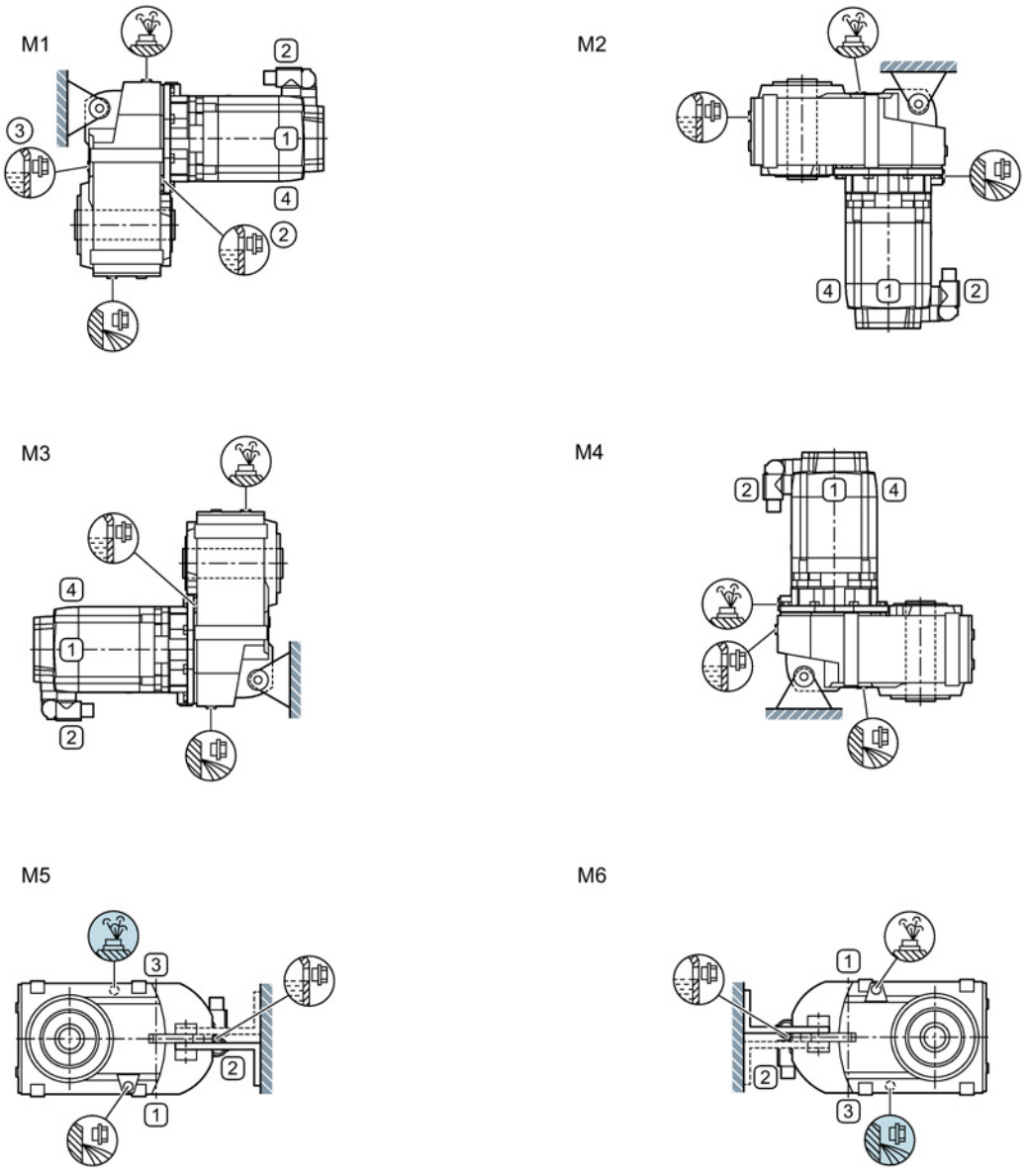


Image 2-13 Mounting positions for parallel shaft gearboxes FZAD and FDAD, shaft-mounted design, sizes 39 - 129,
2-stage and 3-stage

2.2.5.3 Bevel gearbox

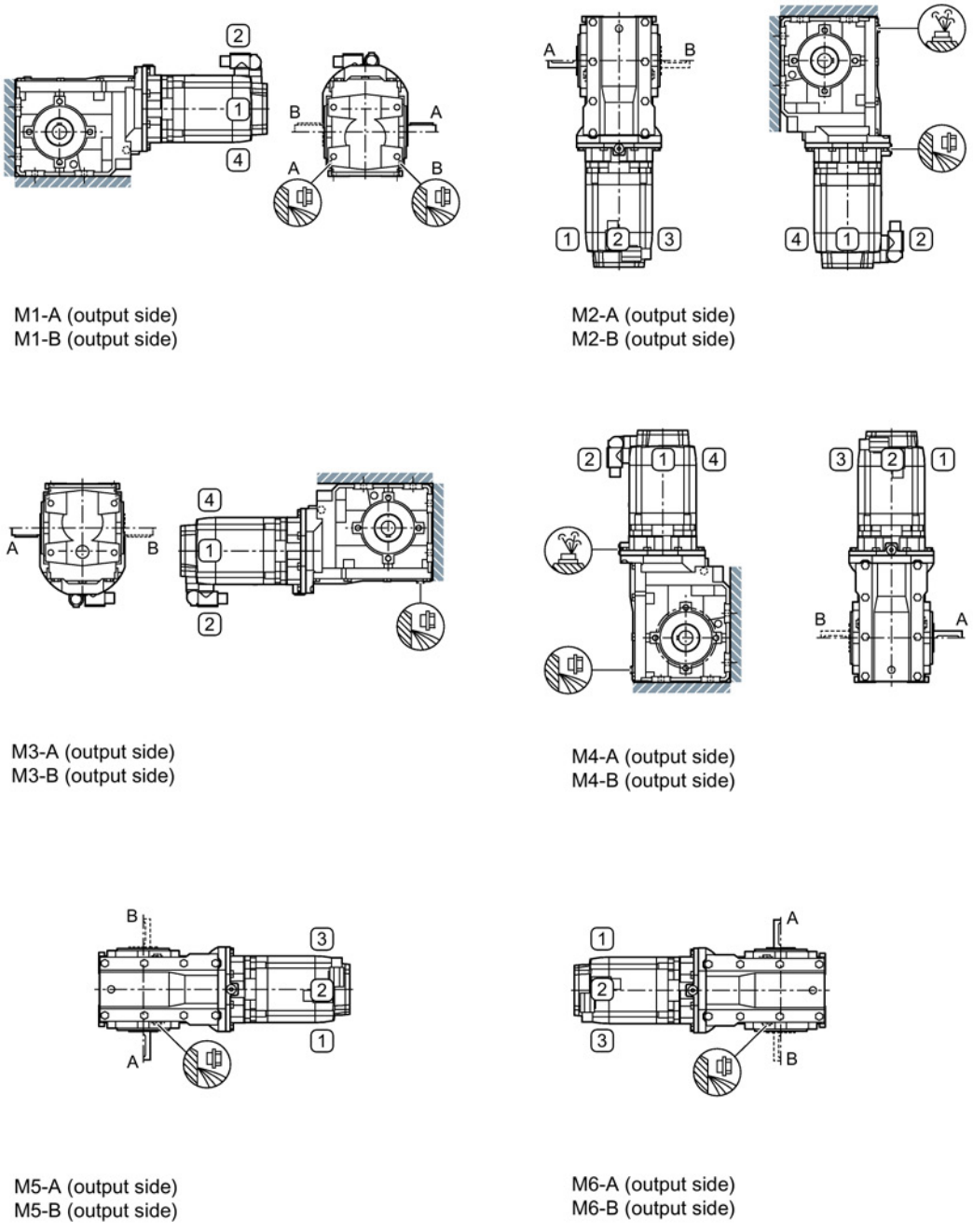
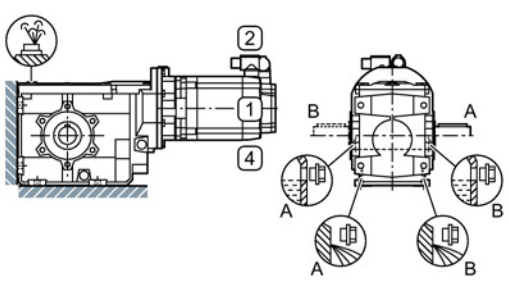
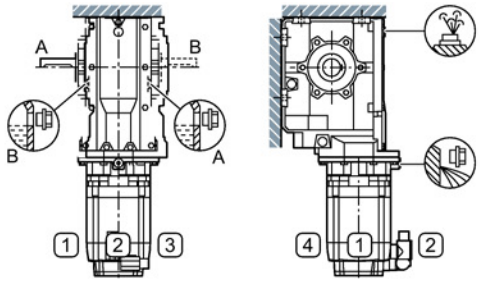


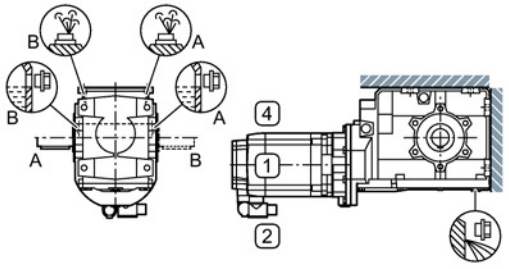
Image 2-14 Mounting positions for bevel gearbox B, foot-mounted design, size 29, 2-stage



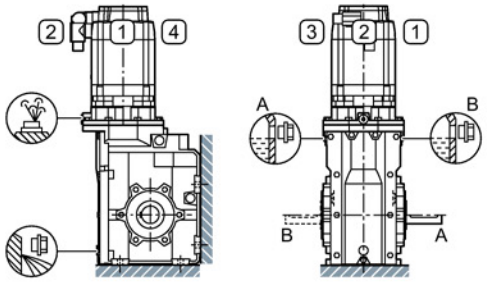
M1-A (output side)
M1-B (output side)



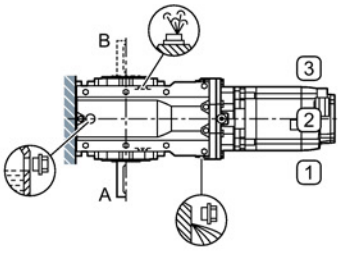
M2-A (output side)
M2-B (output side)



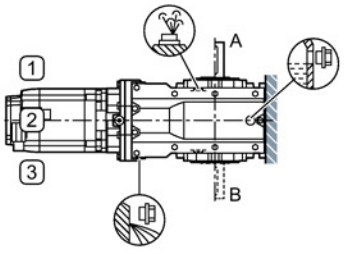
M3-A (output side)
M3-B (output side)



M4-A (output side)
M4-B (output side)



M5-A (output side)
M5-B (output side)



M6-A (output side)
M6-B (output side)

Image 2-15 Mounting positions for bevel gearbox B, foot-mounted design, sizes 39 - 49, 2-stage

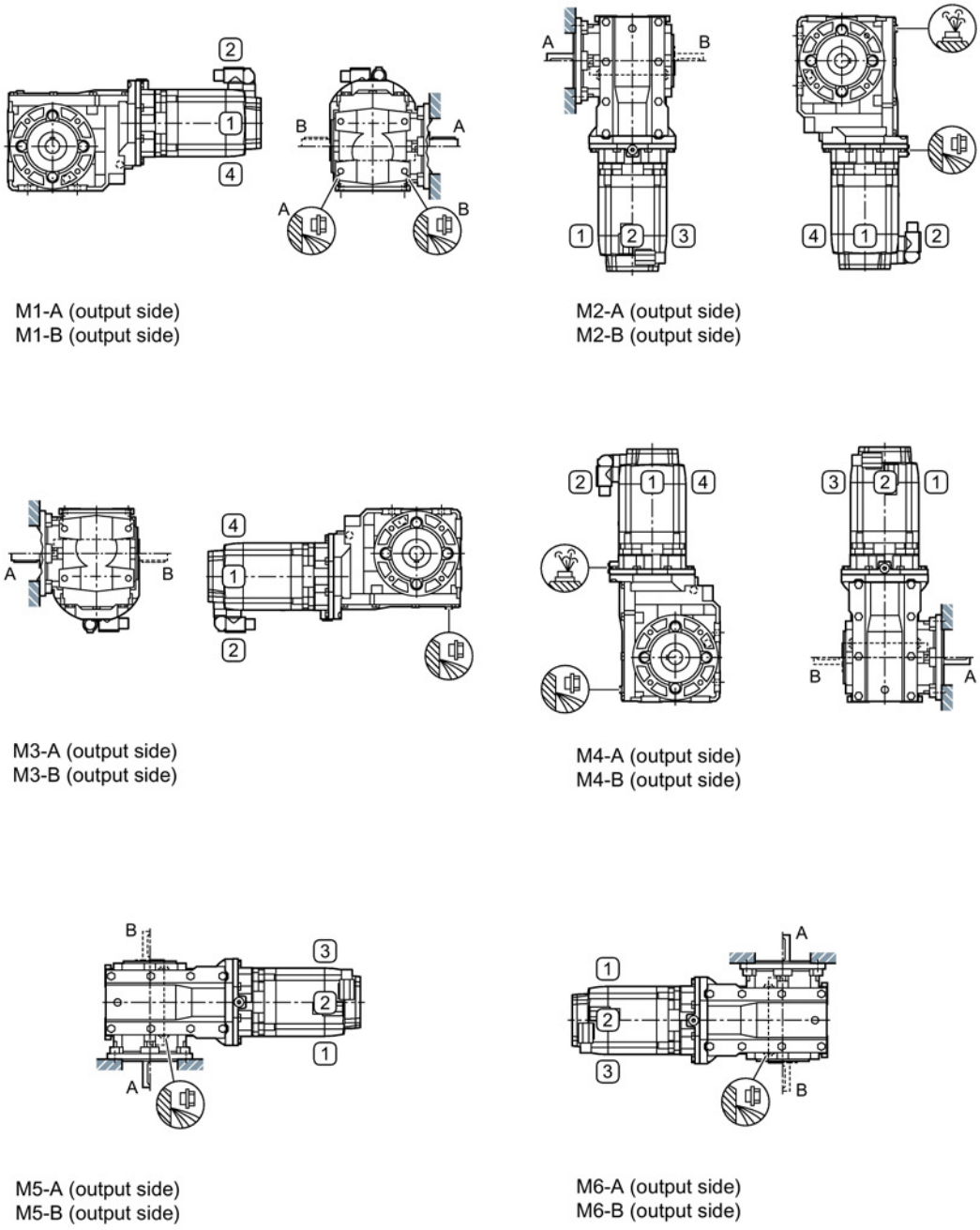
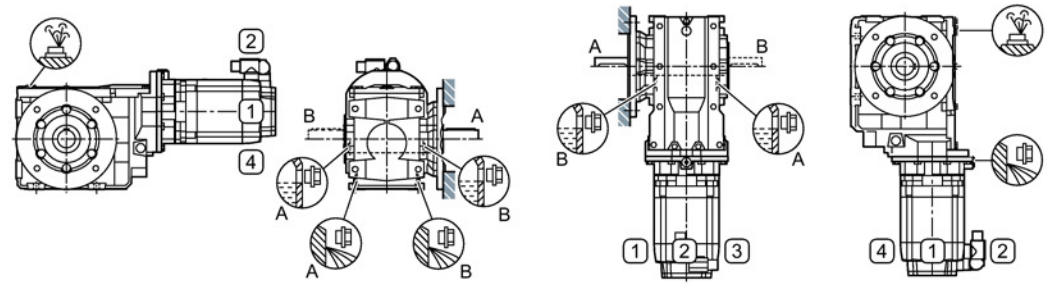
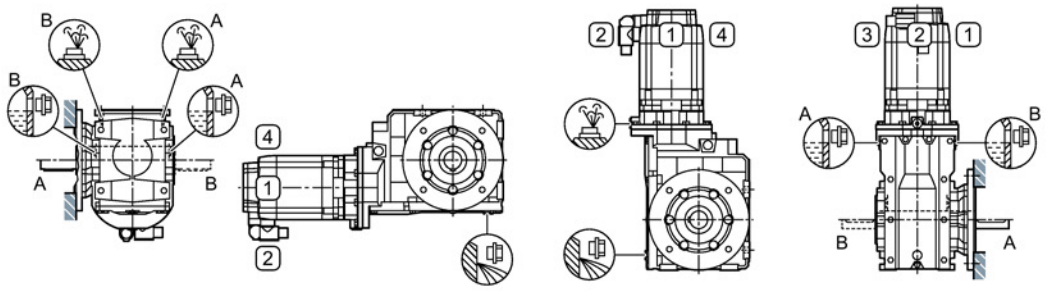


Image 2-16 Mounting positions for bevel gearbox B.Z (flange design), or B.Z (housing flange design). size 29, 2-stage



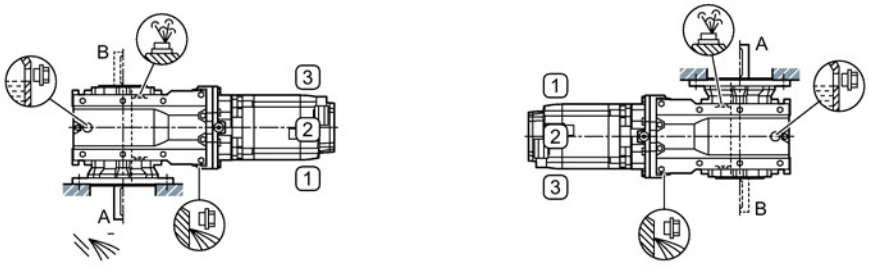
M1-A (output side)
M1-B (output side)

M2-A (output side)
M2-B (output side)



M3-A (output side)
M3-B (output side)

M4-A (output side)
M4-B (output side)



M5-A (output side)
M5-B (output side)

M6-A (output side)
M6-B (output side)

Image 2-17 Mounting positions for bevel gearbox B.Z (flange design), or B.Z (housing flange design), sizes 39 - 49, 2-stage

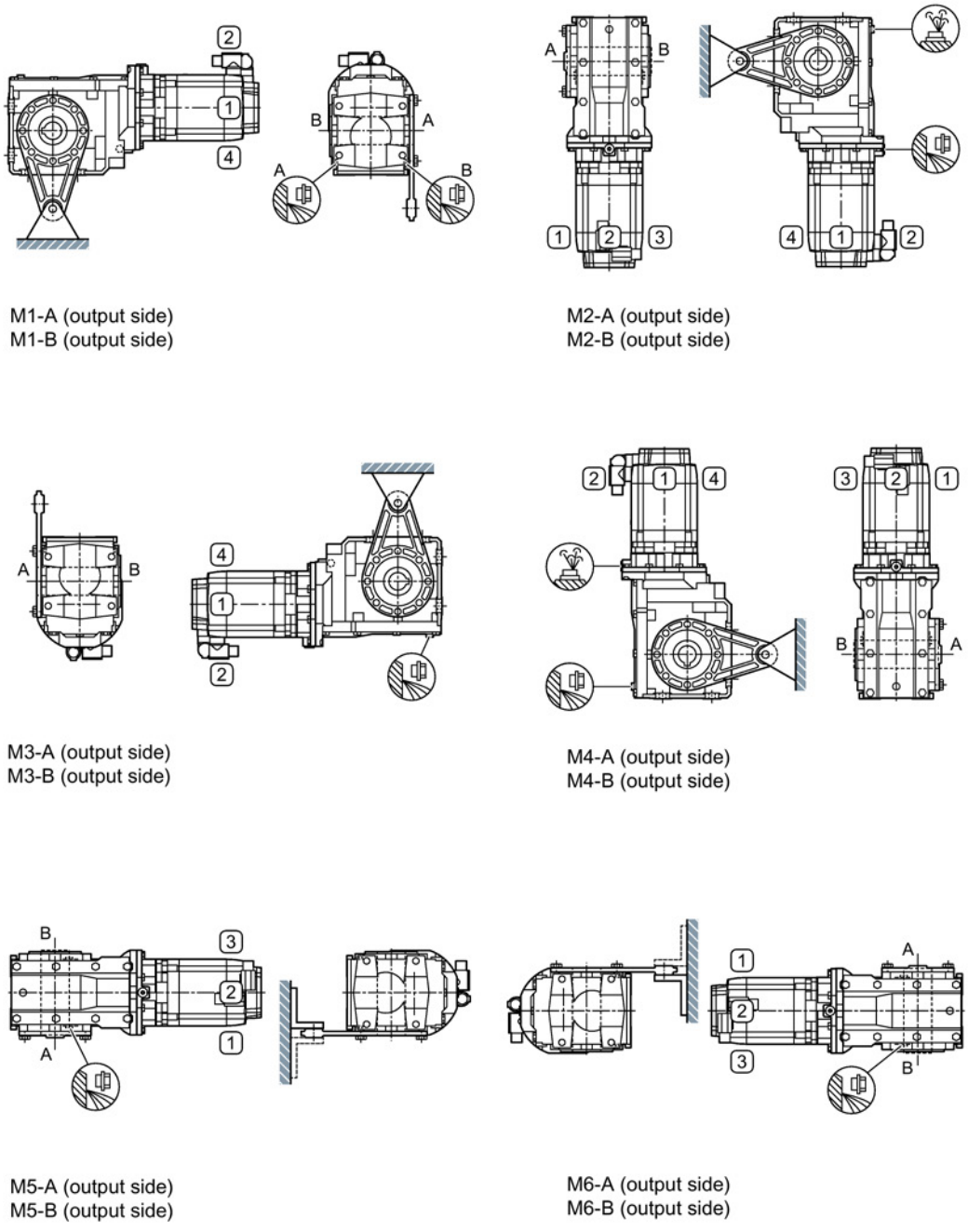


Image 2-18 Mounting positions for bevel gearbox BAD, shaft-mounted design, size 29, 2-stage

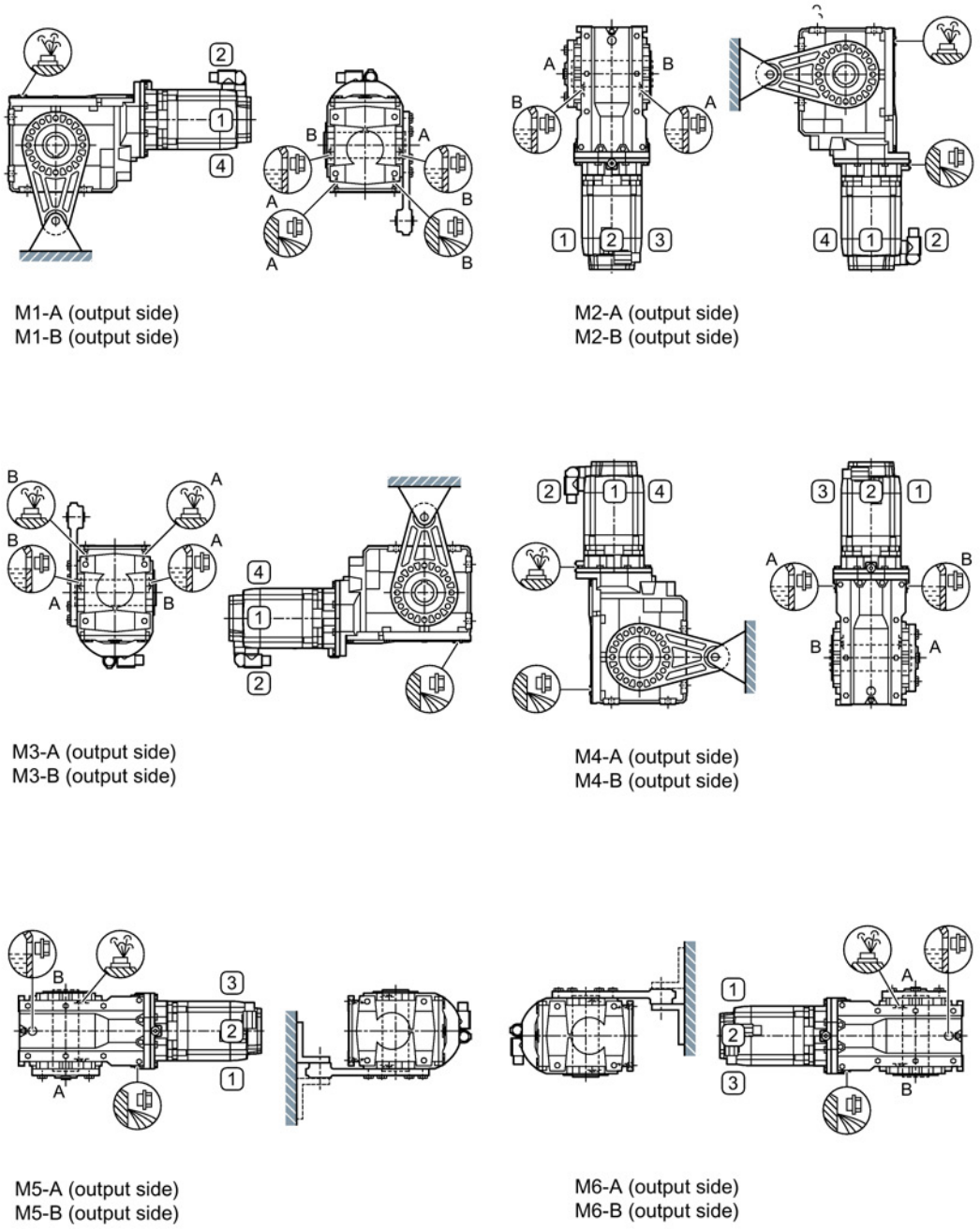


Image 2-19 Mounting positions for bevel gearbox BAD, shaft-mounted design, sizes 39 - 49, 2-stage

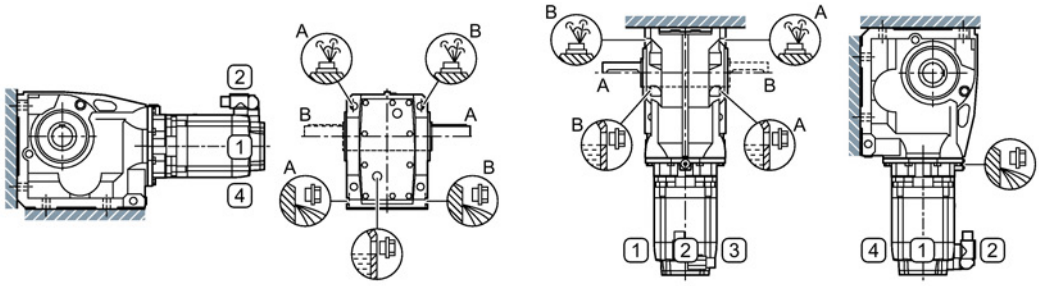


Image 2-20 Mounting positions for bevel gearbox K, foot-mounted design, sizes 39 - 149, 3-stage

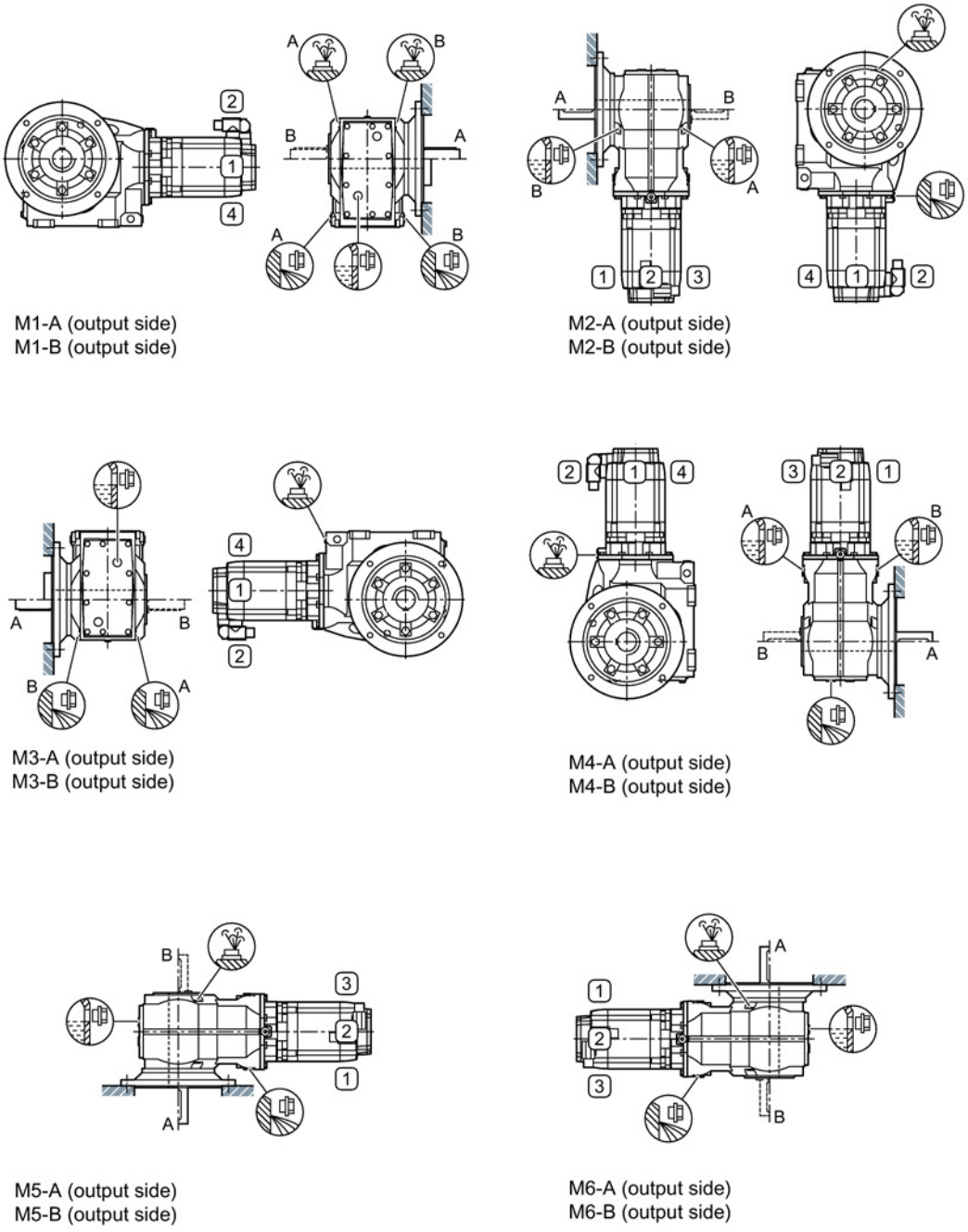


Image 2-21 Mounting positions for bevel gearbox K.F (flange design), and KAZ (housing flange design), sizes 39 - 149, 3-stage

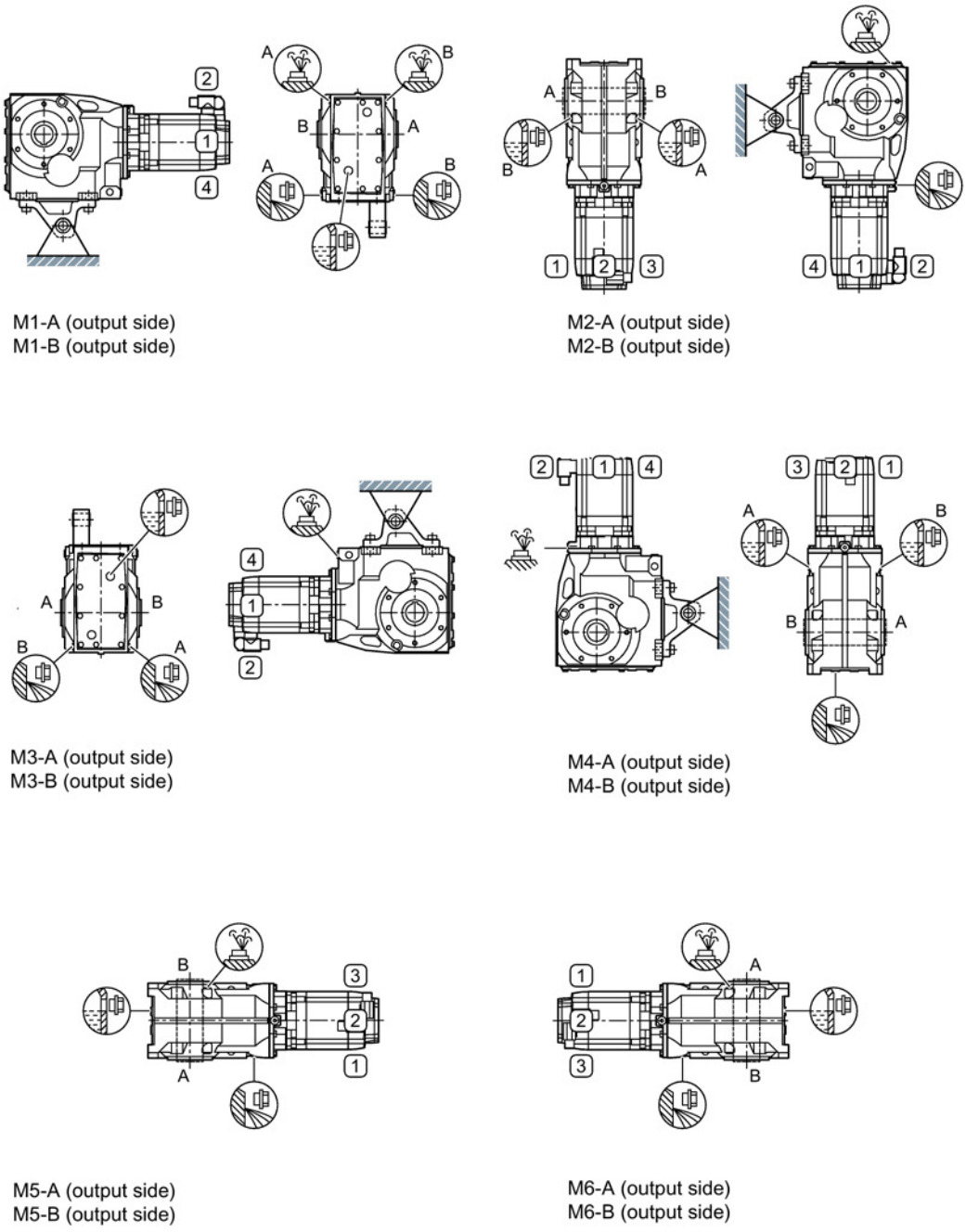
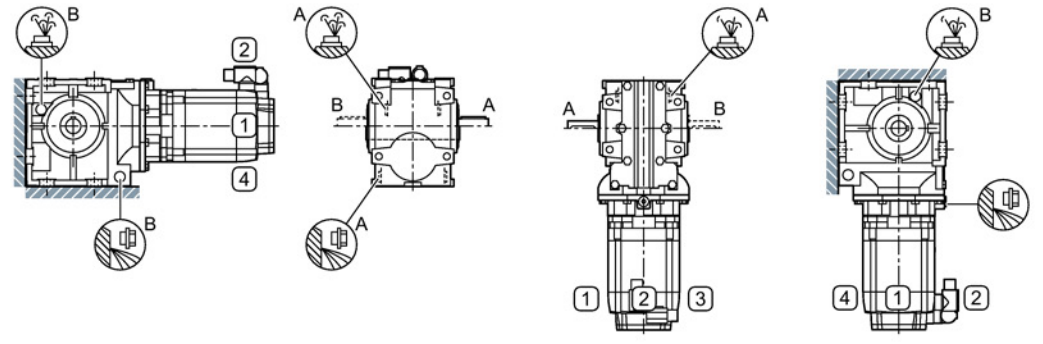


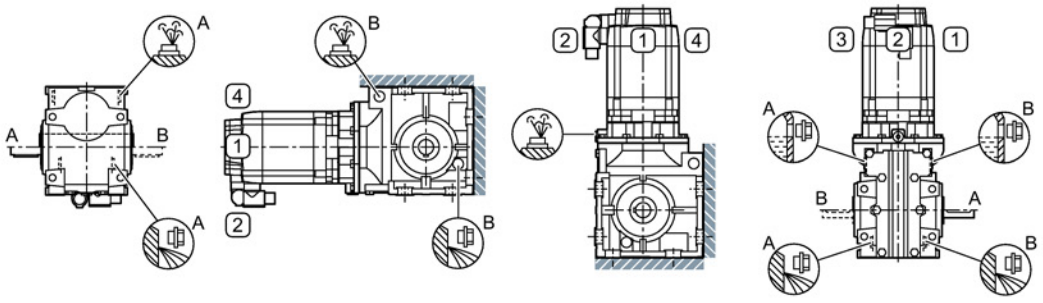
Image 2-22 Mounting positions for bevel gearbox KAD, shaft-mounted design, sizes 39 - 149, 3-stage

2.2.5.4 Helical worm gearbox



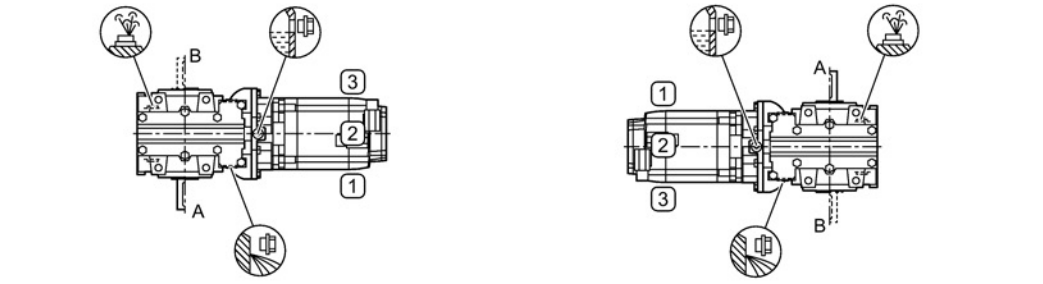
M1-A (output side)
M1-B (output side)

M2-A (output side)
M2-B (output side)



M3-A (output side)
M3-B (output side)

M4-A (output side)
M4-B (output side)



M5-A (output side)
M5-B (output side)

M6-A (output side)
M6-B (output side)

Image 2-23 Mounting positions for helical worm gearbox C, foot-mounted design, size 29, 2-stage

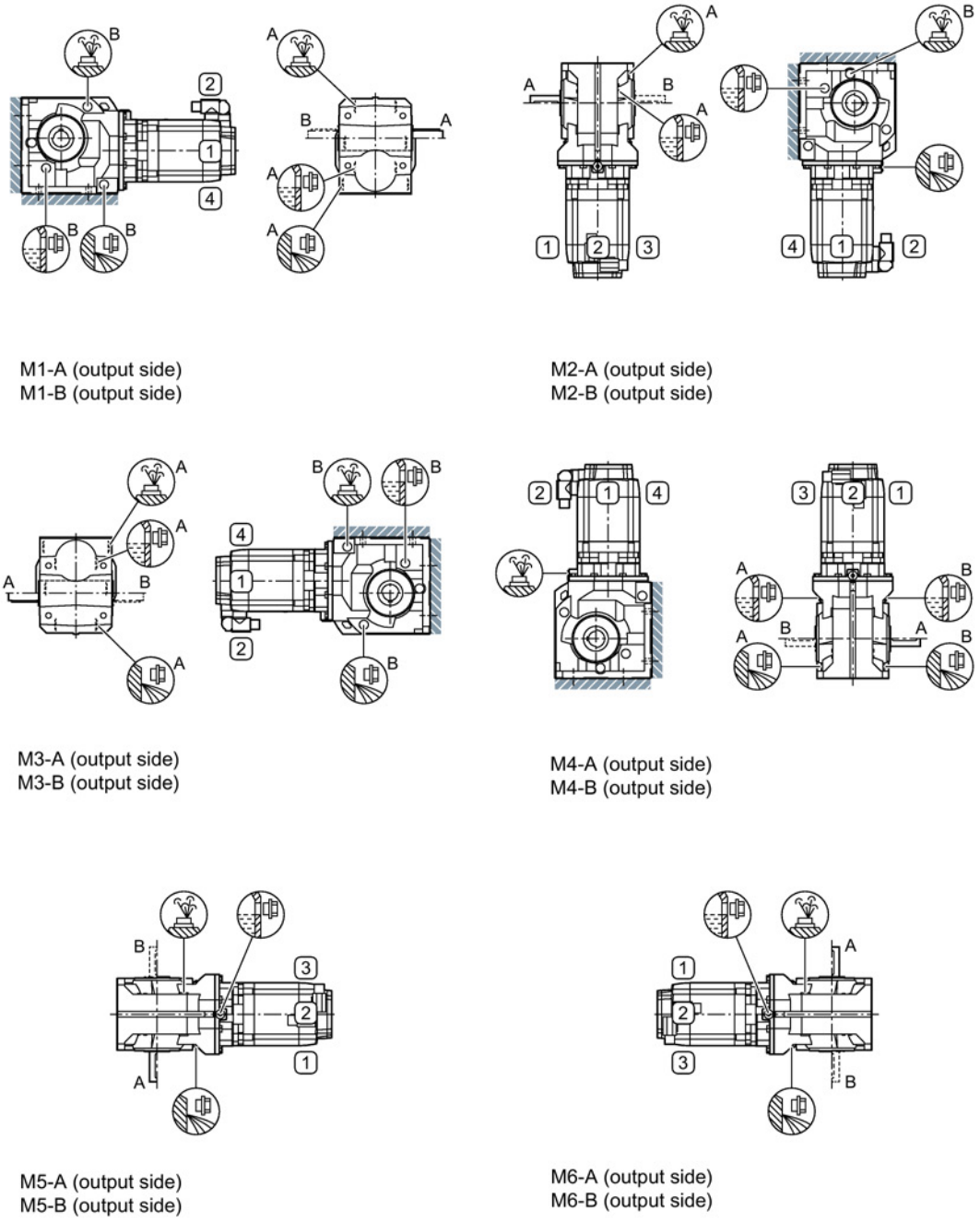
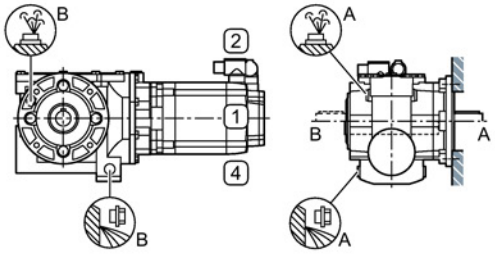
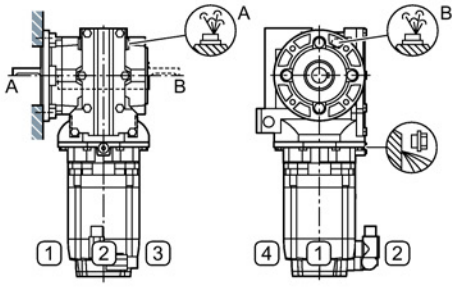


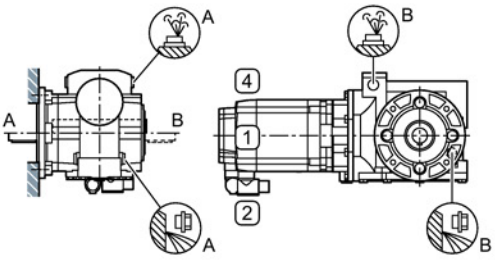
Image 2-24 Mounting positions for helical worm gearbox C, foot-mounted design, sizes 39 - 89, 2-stage



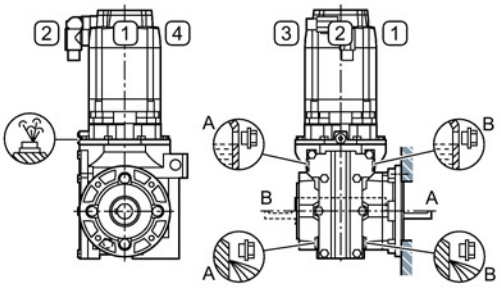
M1-A (output side)
M1-B (output side)



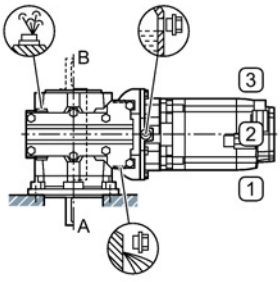
M2-A (output side)
M2-B (output side)



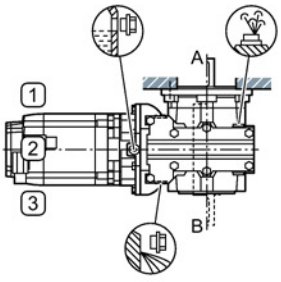
M3-A (output side)
M3-B (output side)



M4-A (output side)
M4-B (output side)



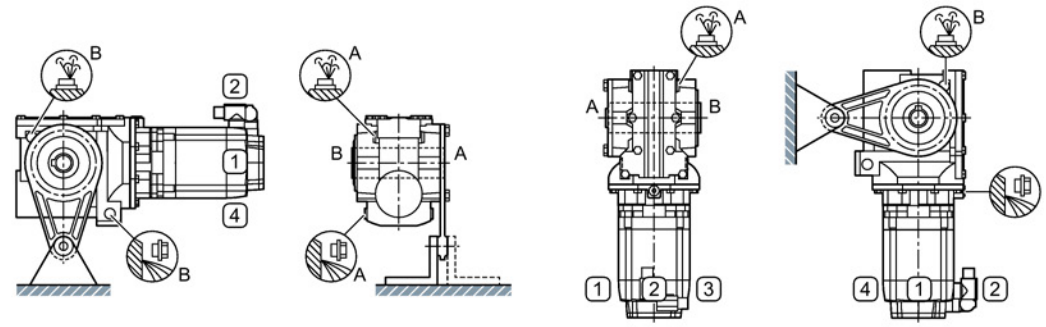
M5-A (output side)
M5-B (output side)



M6-A (output side)
M6-B (output side)

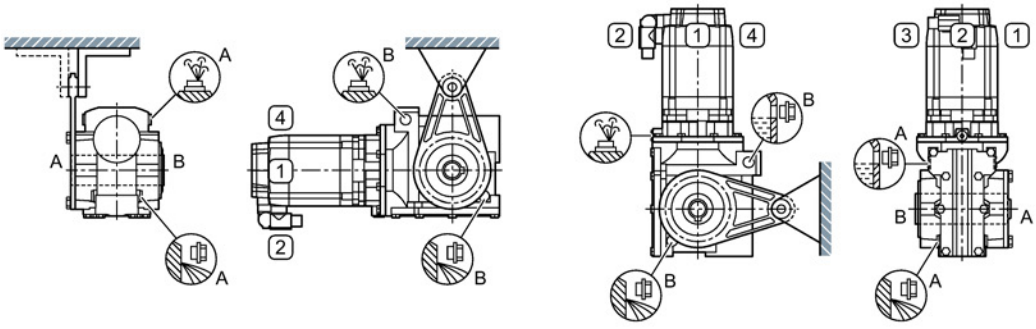
Image 2-25 Mounting positions for helical worm gearbox CF (flange design), and CAZ (housing flange design), size 29, 2-stage

Image 2-26 Mounting positions for helical worm gearbox CF (flange design), and CAZ (housing flange design), sizes 39 - 89, 2-stage



M1-A (output side)
M1-B (output side)

M2-A (output side)
M2-B (output side)



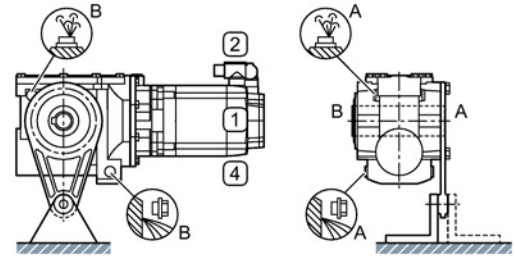
M3-A (output side)
M3-B (output side)

M4-A (output side)
M4-B (output side)

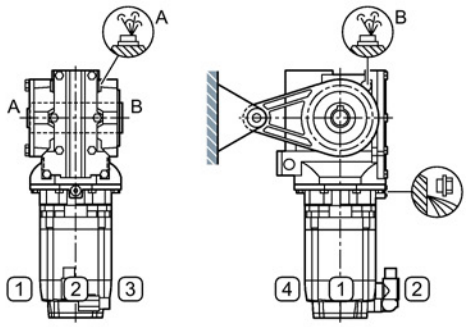
M5-A (output side)
M5-B (output side)

M6-A (output side)
M6-B (output side)

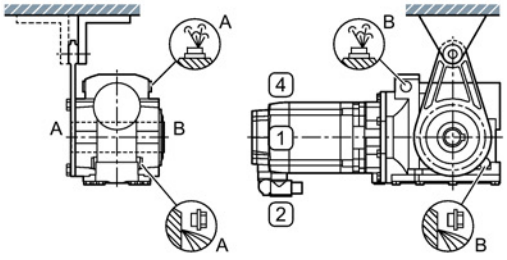
Image 2-27 Mounting positions for helical worm gearbox CAD, shaft-mounted design, size 29, 2-stage



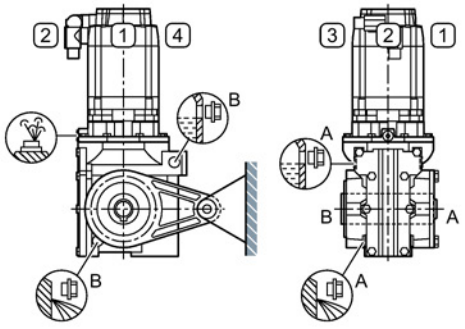
M1-A (output side)
M1-B (output side)



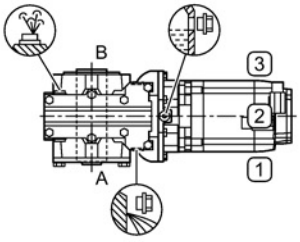
M2-A (output side)
M2-B (output side)



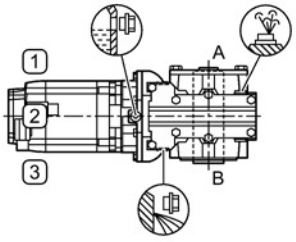
M3-A (output side)
M3-B (output side)



M4-A (output side)
M4-B (output side)



M5-A (output side)
M5-B (output side)



M6-A (output side)
M6-B (output side)

Image 2-28 Mounting positions for helical worm gearbox CAD, shaft-mounted design, sizes 39 - 89, 2-stage

2.2.6 Ambient conditions for use of the servo geared motor

You can classify the ambient conditions for stationary use at weatherprotected locations according to the standard DIN IEC 60721-3-3. The environmental effects and their limit values are defined in various classes in this standard.

You can assign the SIMOTICS S-1FG1 servo geared motors to climate class 3K4 with the exception of the environmental factor "condensation". Condensation is not permissible.

The following temperature ranges apply for natural-cooled and forced-ventilation motors.

Table 2- 3 **Ambient conditions based on climate class 3K4**

Environmental parameter		Unit	3K4 class
a)	Low air temperature	°C	- 15
b)	High air temperature	°C	+ 40
c)	Low relative humidity	%	5
d)	High relative humidity	%	95
e)	Low absolute humidity	g/m^3	1
f)	High absolute humidity	g/m^3	29
g)	Rate of temperature change[1)]	°C/min	0.5
h)	Low air pressure[5)]	kPa	70
i)	High air pressure[2)]	kPa	106
j)	Solar radiation (insolation)	W/m^2	700
k)	Thermal radiation	-	-
l)	Air movement[4)]	m/s	1.0
m)	Condensation	-	Not permissible
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-
o)	Water (other than rain)	-	See protection class
p)	Formation of ice	-	-

1) Averaged over a period of 5 min

2) Conditions in mines are not considered.

3) Climate-controlled locations with a tolerance of ±2 °C, referred to defined limit values.

4) A cooling system based on natural convection can be disturbed by unforeseen air movements.

5) The limit value of 70 KPa covers applications worldwide. (Altitudes up to 3000 m)

Note

Additional data on the ambient conditions

You will find additional data on the ambient conditions, such as ambient temperatures or conditions for transportation and storage of the motors, in the relevant chapters of this documentation.

For deviating conditions (ambient temperature > 40° C or installation altitude > 1000 m above sea level), you can determine the thermally permissible torques and powers from the table below. Ambient temperatures and installation altitudes are rounded up to 5°C and 500 m respectively.

Table 2- 4 Derating of the thermally permissible power as a function of the installation altitude and ambient temperature

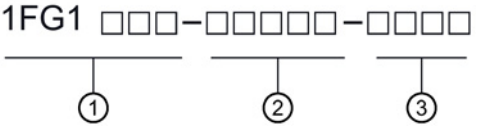
Installation altitude above sea level [m]	Ambient temperature in °C				
	< 30	30 - 40	45	50	55
1000	1.07	1.00	0.96	0.92	0.87
1500	1.04	0.97	0.93	0.89	0.84
2000	1.00	0.94	0.90	0.86	0.82
2500	0.96	0.90	0.86	0.83	0.78
3000	0.92	0.86	0.82	0.79	0.75
3500	0.88	0.82	0.79	0.75	0.71
4000	0.82	0.77	0.74	0.71	0.67

The factors refer to the static torque M_0. You shift the S1 characteristic in parallel.

2.3 Structure of the article number

The following overview describes the structure of the article number.

The article number comprises a combination of digits and letters. To obtain a better overview, the article number is split up into three, hyphenated blocks.



1 Designation of gearbox type and gearbox size
2 Designation of output shaft and motor type
3 Further design features

Image 2-29 Structure of the article number

You can find possible combinations in the Catalog D41.

Note

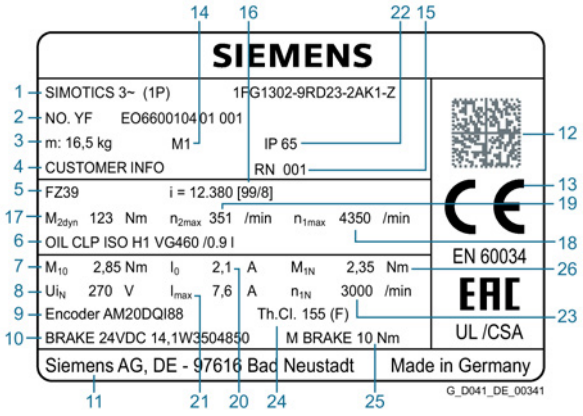
Note that not every theoretical combination is possible in practice.

Structure of the article number

Image 2-30 Structure of the article number

2.4 Rating plate specifications of the servo geared motor

The rating plate contains the technical data applicable to the delivered motor. A second rating plate is provided with the motor, and can be used for documentation purposes.



1	Product name, three-phase motor, article number (without order codes)	14	Mounting position
2	Factory number (ID No., production number)	15	Revision number
3	Total weight [kg]	16	Gear ratio
4	Ordering data for Y84	17	Maximum output torque in short-time duty [Nm]
5	Gearbox type	18	Max. permissible speed input side [rpm]
6	Gearbox oil/gearbox oil quantity [l]	19	Max. permissible speed output side [rpm]
7	Permanent static torque [Nm]	20	Stall current [A]
8	Induced voltage [V]	21	Maximum current [A]
9	Encoder type	22	Degree of protection
10	Brake type	23	Rated speed of the motor (irrespective of the gearbox) [rpm]
11	Manufacturer's address, country of origin	24	Temperature class
12	2D code - factory number + article number (without order codes)	25	Braking torque (only for spring-loaded brake) [Nm]
13	Certifications; EN 60034/UL/CE/EAC/CSA	26	Rated torque

Image 2-31 Rating plate 1FG1

2.5 Type designation of the gearbox

Table 2- 5 Type designation key for the gearbox

Gearbox type		
(-)		Helical gearbox
B		Bevel gearbox, two-stage
K		Bevel gearbox, three-stage
F		Parallel shaft gearbox
C		Helical worm gearbox
Stage		
Z		Two-stage
D		Three-stage
Type		
	Shaft	
	(-)	Solid shaft
	A	Hollow shaft
	Fixing	
	(-)	Foot-mounted design
	B	Foot/flange-mounted design
	F	Flange-mounted design (A type)
	Z	Housing flange (C type)
	D	Torque arm
	Connection	
	(-)	Parallel key
	S	Shrink disk
	T	Hollow shaft with splines
	R	SIMOLOC

Table 2- 6 Example of the type designation structure

Example	**F**	**D**	**A**	**D**	**S**	**89**
Gearbox type	F					
Transmission stage		D				
Shaft			A			
Mounting				D		
Connection					S	
Size						89

Gearbox designation at the 5th position of the article number

Gearbox type	Identification letter	Number of stages	Identification letter	Designation at the 5th position of the article number
Helical gearbox	-	Two-stage	Z	1
Helical gearboxes	-	Three-stage	D	2
Parallel shaft gearbox	F	Two-stage	Z	3
Parallel shaft gearbox	F	Three-stage	D	4
Bevel gearbox	B/K	Two-stage/three-stage	(-)	5
Helical worm gearbox	C	Two-stage	(-)	6

2.6 Configuration

2.6.1 Cooling of the servo geared motor

The 1FG1 is naturally cooled.

The housing surface is sufficient for dissipating heat losses where there is free convection.

Note

Dust deposits prevent heat radiation

Dust deposits prevent heat radiation and cause a high housing temperature.

- Keep the 1FG1 free of contamination, dust and other deposits.

The rating data of the 1FG1 apply only up to an ambient temperature of 40 °C (104 °F).

To ensure sufficient cooling of the 1FG1, maintain a minimum clearance of 100 mm from adjacent components on three lateral surfaces.

If the gearbox housing temperature exceeds a value of +80° C, please contact Technical Support.

2.6.2 Holding brake

2.6.2.1 Properties

The holding brake is used to clamp the motor shaft when the motor is at a standstill. The holding brake is **not** a working brake for braking the rotating motor.

The holding brake can be implemented as a permanent-magnet brake or a spring-loaded brake.

⚠ WARNING

Danger to life caused by unintended movements of the machine or installation

If you use the holding brake improperly, e.g. as a safety brake, or you ignore the number of operations of the brake, the braking effectiveness of the holding brake can be irreversibly reduced. This can cause unintended movements of the machine or installation resulting in death or serious injury.

- Observe the permissible number of operating cycles.
- Operate the motor only in conjunction with an intact brake.

NOTICE
Faulty brake function due to inadmissible wear Inadmissible wear means that the braking function can no longer be guaranteed. • Comply with the predefined emergency stop characteristics. • Avoid repeated brief acceleration of the motor against a holding brake that is still closed. Consider the operating times of the brakes and the relays in the drive control and enable.

Principle of operation

The holding brake operates according to the closed-circuit principle. It brakes when the current is interrupted and holds the motor.

When power is applied to the brake, it is opened and the motor is free to rotate.

When the power fails or an emergency stop is issued, the motor is braked from its actual speed down to standstill.

Note

Forbidden areas of application of the holding brake

The holding brake must not be used in hazardous areas/areas subject to firedamp.

Note

Subsequent conversion of motors with or without a holding brake is not possible.

Motors with a holding brake are longer by the installation space required for the holding brake. (See dimension drawings in the Configuration Manual)

Setting up the brake

The rated voltage of the holding brake is 24 V DC +/- 10%. Voltages outside this tolerance range can cause faults.

When setting up machines and systems (jog mode), observe the technical data for the holding brakes in the "Configuration" chapter of the catalog.

2.6.2.2 Motor-side connection of the holding brake

The holding brake in the motor is intended for direct connection to the SINAMICS inverter using the MOTION CONNECT power cable with an integrated brake connection cable, see chapter "Connecting-up a converter (Page 123) "

Since safe electrical isolation from the motor winding is guaranteed for the brake cable in the motor and the power cable is designed as an enforced insulation, no further protection circuits are required in this case.

2.6.2.3 Protective circuitry for the brake

The holding brake can be operated via an external power supply.

The external power supply can be a PELV (PELV = Protective Extra Low Voltage) supply, because:

- safe electrical isolation from the motor winding is guaranteed for the brake cable in the motor and
- the power cable has reinforced insulation.

Note

The relay K1, located between coil and contact, must also have reinforced insulation to protect the internal logic voltage.

If you control the holding brake via an external power supply, you must protect the holding brake from voltage peaks with a protective circuit. See the figure "Suggested circuit for the external power supply"

The protective circuit also ensures the specified switching times. See the table "Technical data of the holding brakes used"

To ensure fault-free release of the brake, a minimum voltage of 24 V DC -10 % must be applied to the connector on the motor side.

If the maximum voltage of 24 V DC +10% is exceeded, the brake can re-close.

When providing the voltage, take account of the voltage drop across the brake supply cable.

You can calculate the voltage drop ΔV for copper cables approximately as follows:

$_{\Delta}U\ [V] = 0.042 \times (l/q) \times I_{brake}$

l = Cable length [m]
q = Brake core cross section [mm^2]
I_{brake}= Direct current of the brake [A]

Note

Integrate a protective circuit into the incoming cable. In this way, you avoid switching overvoltages and possible influence of the installation environment. See the figure below

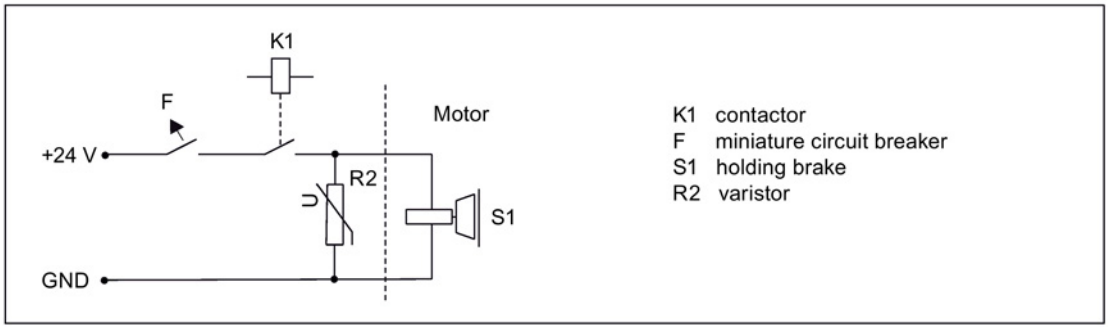


Image 2-32 Suggested circuit for the external power supply with protective circuit

Table 2- 7 Example: Electrical components for the suggested circuit

Electrical component	Examples		
F	3RV10 circuit-breaker with current paths connected in series (if required with mounted auxiliary contact 3RV1901 to provide a feed-back signal for the drive).	or	Miniature circuit-breaker 5SX21 (if required with mounted auxiliary contact to provide a feedback signal for the drive).
K1	Auxiliary contactor 3RH11	or	Contactor 3RT10
R2	Varistor SIOVS14K30 (EPCOS)		

2.6.2.4 Permanent-magnet brake

The permanent-magnet brake is one type of holding brake.

The magnetic field of the permanent magnets exerts a pulling force on the armature disk of the holding brake. This means that in the no-current condition, the brake is closed and the motor shaft is held (closed-circuit principle).

When 24 V DC rated voltage is applied to the brake, the current-carrying coil produces an opposing field. This neutralizes the force of the permanent magnets and the brake opens without any residual torque.

For the technical data, see the "Configuration" chapter of the catalog.

2.6.2.5 Spring-loaded brake

The spring-loaded brake is another type of holding brake.

Principle of operation

The spring-loaded brake is an electromagnetic device that uses the force of an electromagnetic field to release the braking effect created by the force of a compressed spring (electromagnetically opening system).

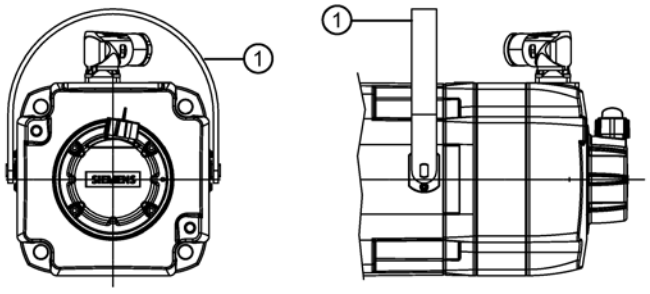
It also works according to the closed-circuit principle.

Technical data of the spring-loaded brake

For the technical data, see the "Configuration" chapter of the catalog.

Manual brake release option

To release the braking torque, you can order the servo geared motor with spring-loaded brake optionally with manual brake release.



1 Manual release handle

Image 2-33 Spring-loaded brake with manual release handle

Manual brake release is the manual opening of the spring-loaded brake using a removable handle called the manual release handle. The braking torque of the spring-operated brake is released.

Note

Permissibility of manual brake release

Before use, check that manual brake release is permissible in your installation.

WARNING

Danger to life caused by unintended movements of the machine or installation

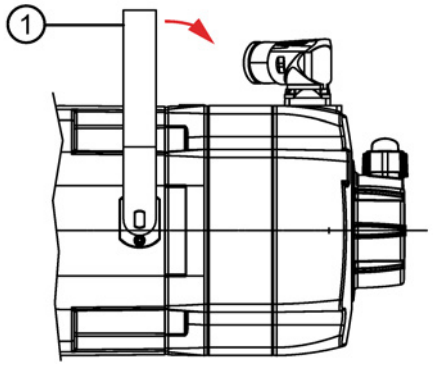
You can release the braking effect of the spring-loaded brake with the mechanical manual brake release. Unintended movements of the machine or installation can result in death or serious injury.

- Mount the braking resistors so that unintended actuation of the manual release handle is not possible.
- Place the manual release handle in the vertical position to ensure the full effect of the brake. Remove the manual release handle.
- Mount the manual release handle first for releasing the spring-loaded brake.
- Make sure that the electrical installation or machinery cannot cause any damage when releasing the spring-loaded brake.
- If the manual release handle cannot be placed in the vertical positon, shut down the installation or machine immediately.
- Start the installation again only when proper functioning of the manual brake release is ensured.
- Disassemble the manual release handle during normal operation.

Releasing the brake

Procedure

1.
2.



1 Manual release handle

Press the manual release handle in the direction of the NDE.

→ The spring-loaded brake is mechanically released.

You have neutralized the braking force.

Securing the manual break release

In the unactuated state, the manual release handle must be in the vertical position, see figure. Only in this position is the brake fully closed and the full braking effect ensured. The manual release handle can only be removed in the vertical position.

Procedure

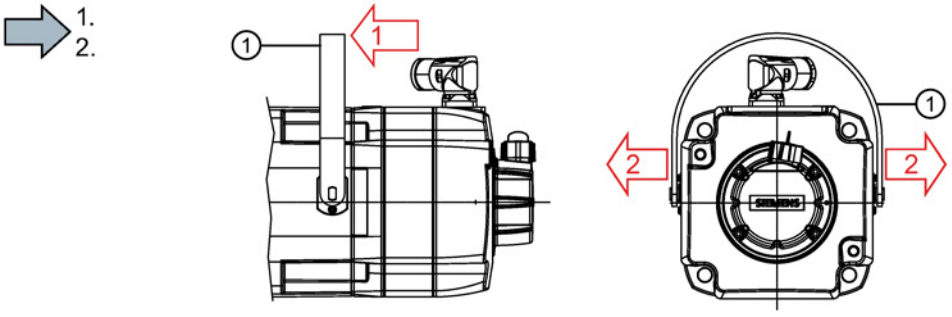


Image 2-34 Removing the manual release handle of the spring-loaded brake

1. Place the manual release handle in the vertical position
2. Remove the manual release handle.

You have secured the spring-loaded brake against unintended actuation.

Option: mechanical break release monitor

To monitor wear and tear on the spring-loaded brake, you can order the servo geared motor optionally with an opening for mechanical break release monitor.

CAUTION

Danger of injury from ejected particles

When opening the cover of the break release monitor, loose particles can be ejected and cause injury.

- Switch the motor off before opening the cover.
- Open the cover only when the motor is at a standstill.
- Before switching the motor on again, close the cover to the break release monitor.

You can use the mechanical break release monitor to check the width of the air gaps of the spring-loaded brake. The width of the air gap indicates the state of wear of the armature disk. The wider the air gap, the greater the wear on the armature disk.

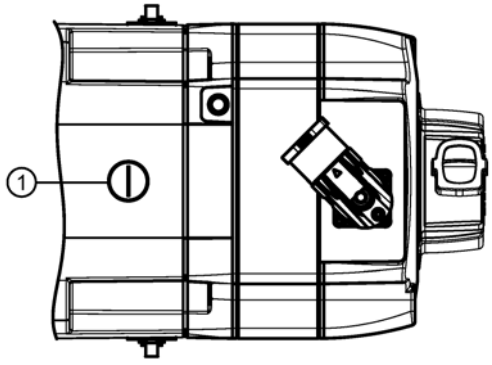
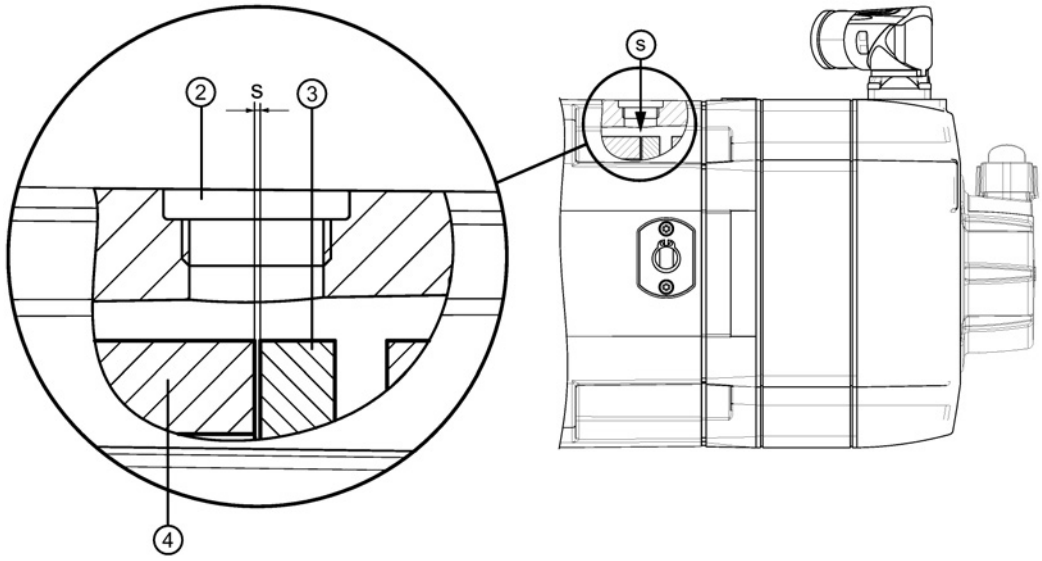


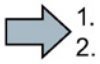
Image 2-35 View from above



1 Screw plug of the mechanical break release monitor
2 Opening for mechanical break release monitor
3 Armature disk
4 Brake housing
s Air gap

Image 2-36 Side view

Wear check



Procedure

1. Shut down the motor.
2. Remove the screw to the opening of the break release monitor.
3. Calculate the distance s between the brake housing and the armature disk using a thickness gauge.
4. Compare the calculated width of the air gap with the table below.

	1FG1□□□-□□F□□-□□□□	1FG1□□□-□□G□□-□□□□
Air gap s [mm] in new state	$0.20^{+0.03}$	$0.20^{+0.03}$
Maximum permissible air gap s_{max} [mm] (at 70% of the rated current)	0.44	0.70

When the air gap reaches the value s_{max}, the wear limit of the brake has been reached.

For continued functional safety, you must replace the brake. You cannot adjust the brake.

Consult your Siemens representative.

Preparing for use

3

3.1 Safety instructions

⚠ WARNING

Danger to life as a result of incorrect transport and/or lifting of the motor

Incorrectly transporting and/or lifting the geared motor can result in death, severe injury, and/or damage to property. For instance, the geared motor can fall.

- Lift the geared motor using only the lifting eyes and eyebolts on the gearbox.
- Use all of the lifting eyebolts when transporting.
- Do not attach a lifting eyebolt to the shaft extension.
- Use a crossbeam if you lift and/or transport the geared motor using the eyebolts provided. Note the following:
  - Do not use bent or damaged eyebolts.
  - Completely screw in the eyebolts (lifting eyes) and tighten by hand.
  - Loads that run transverse to the ring plane are not permitted.
  - When attaching by a number of chains and ropes just two strands must be sufficient to bear the entire load.
  - Secure the load suspension equipment against slippage.

⚠ WARNING

Danger to life through incorrect or unused lifting points

Due to incorrect or unused lifting points, the motor can fall and cause death, severe injury and/or damage to property.

Eyebolts must not be screwed into the front threads of the shaft extensions.

Loads applied transversely to the plane of the eyebolts are not permitted.

- Lift and transport large motors using the eyebolts screwed on to the end shields.
- Completely screw in the eyebolts and tighten by hand (approx. 8 Nm).
- Do not use bent or damaged eyebolts.
- Use only eyebolts with laminated fiber washers.

⚠ WARNING

Danger of severe injury due to unintentional movements of the motor

If the motor is not secured after being set down, unintentional movements of the motor can cause serious injury.

- After the motor has been set down, secure it in position.
- Do not release the lifting devices until the motor has been secured in position.

3.2 Shipping and packaging

Packaging

The 1FG1 servo geared motors are delivered already assembled. Additional items are shipped in separate packaging if applicable.

- Please pay attention to the handling notes on the packaging when the servo geared motor is delivered

Table 3- 1 Handling notes and their meaning

Symbol	Meaning	Symbol	Meaning
	Fragile (ISO 7000, No. 0621)		Keep dry (ISO 7000, No. 0626)
	Top (ISO 7000, No. 0623)		Do not stack (ISO 7000, No. 2403)

Scope of delivery of a servo geared motor

- Upon receipt of the delivery, check immediately whether the items delivered are in accordance with the accompanying documents.

Note

Siemens will not accept any claims relating to items missing from the delivery and which are submitted at a later date.

- Register a complaint about
  - any apparent transport damage with the transport company immediately
  - any apparent defects or missing components with the appropriate SIEMENS office immediately.

The safety instructions are included in the scope of delivery.

The delivery includes a second rating plate. The second rating plate can be used to post the motor data additionally in the vicinity of the servo geared motor.

Special versions and construction variants may differ in the technical details and scope of delivery.

Note

Store the safety instructions so they are always available.

Unpacking the servo geared motor

NOTICE
Damage to the servo geared motor due to improper transport
Transport damage can impair the correct functioning of the servo geared motor.
Never commission faulty or defective servo geared motors.

- Check the servo geared motor for completeness and for damage.
- Report any missing parts or damage immediately.
- Remove and dispose of the packaging material and transport fixtures in accordance with local national regulations.

3.3 Transportation and storage

3.3.1 Transporting the servo geared motor

Note

Comply with the local national regulations for the transportation of servo geared motors.

- Transport and store the servo geared motors in the original packaging.
- Use suitable load suspension equipment when transporting and installing.
- Transport the servo geared motor carefully.

Lifting and transporting the motor using a crossbar

⚠ WARNING

Danger to life due to falling servo geared motors

The threads for eyebolts in the motor housing are not designed for carrying the entire servo geared motor.

If you lift the servo geared motor only by the eyebolts in the motor housing, the eyebolts can be ripped out of the threads and cause death or serious injury.

- For transporting, screw the eyebolts into the threads in the gearbox housing depending on the position.
- Use the threads for the eyebolts in the motor housing only for position stabilization.
- Observe the maximum load of the eyebolt in accordance with the table below.

Transport the servo geared motor by the lifting eyes or eyebolts in the gearbox housing.

Because they are designed only for the weight of the geared motor, it is not permissible to add additional loads to the lifting eyes and eyebolts.

Use a crossbar for lifting and transporting the servo geared motor.

Procedure

1. Screw the lifting eyes (eyebolts) in at appropriate locations for the orientation of the servo geared motor during transportation. Use laminated fiber washers.
2. Hook the beam into the lifting eyes (eyebolts).

You have suspended the servo geared motor for safe transportation.

Table 3- 2 Maximum load of the eyebolt on the gearbox

Thread size	m	d_3	Thread size	m	d_3
	[kg]	[mm]		[kg]	[mm]
M8	140	36	M20	1 200	72
M10	230	45	M24	1 800	90
M12	340	54	M30	3 200	108
M16	700	63	-	-	-

Setting the servo geared motor down

Procedure

1. Set the servo geared motor down on a hard, level surface.
2. Secure the servo geared motor against unintentional movements.

You have set the servo geared motor down in a stable position.

3.3.2 Storing the servo geared motor

Storage

The free shaft ends, sealing elements and flange surfaces of the servo geared motor must have a protective coating.

NOTICE
Seizure damage to bearings If the motors are stored incorrectly, bearing seizure damage can occur, e.g. brinelling, as a result of vibration. • Comply with the storage conditions.

Storage conditions

Please observe the warning instructions on the packaging and labels.

Store the servo geared motor in a dry, dust-free and vibration-free indoor storage facility.

Adhere to the following values:

- v_{rms} < 0.2 mm/s
- Max. temperatures: -15 °C to 70 °C
- Mean relative humidity < 75%

Long-term storage

Note

In the case of storage in transit over 6 months, special arrangements must be made for preservation.

- Contact Technical Support.

If you store the servo geared motor for longer than six months, the storage facility must satisfy the following conditions:

- The motor is protected against extreme weather conditions
- The facility air must be free from aggressive gases.
- The facility air must be free from vibrations (v_{eff} < 0.2 mm/s)
- In accordance with EN 60034-1, the temperature must lie in the range -15° C to 70° C.
- The relative humidity of the air must be less than 60%.

Check the correct state of the servo geared motor every six months.

- Check the servo geared motor for any damage.
- Perform any necessary maintenance work.
- Check the state of the dehydrating agent and replace when necessary.
- Record the preservation work so that all preservation coating can be removed from the servo geared motor prior to commissioning.

Assembly

4

4.1 Safety instructions

⚠ WARNING

Danger to life from permanent magnet fields

Even when switched off, electric motors with permanent magnets pose a potential risk for persons with heart pacemakers or implants if they are close to inverters/motors.

- If you have a heart pacemaker or implant, keep a minimum distance of 20 cm.
- When transporting or storing permanent magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transporting by air.

⚠ WARNING

Danger to life due to freely rotating parts

Contact with rotating parts can cause death or severe injury.

- Do not touch any rotating parts
- Mount a cover cap or protective shroud over freely rotating parts.

⚠ WARNING

Danger to life due to unpredictable movements of the system

The system can perform unpredictable movements under load that can cause death or severe injury.

- De-energize the system before starting work.
- Disconnect all loads from the system.
- Secure the system against accidental reclosing.

NOTICE

Irreparable damage to gearbox components and bearings due to welding

During welding work on the gearbox, components in the gearbox can become unintentionally welded together due to the temperatures generated.

- Do not carry out any welding work on the gearbox.
- Do not use the gearbox as a grounding point for welding operations.

NOTICE

Gearbox damage resulting from impermissible housing loads during installation

If the gearbox is put under stress when tightening the fixing screws, functional faults and damage to the gearbox can result. Striking with tools when installing and dismantling the drive and drive elements can cause damage to the gearbox.

- Ensure a level assembly surface.
- Clean the gearbox installation surface prior to assembly.
- Arrange the parts in such a way that no stress arises when they are secured.
- Assemble and disassemble the input and output elements without striking with tools.

NOTICE

Gearbox damage through overheating from exposure to strong sunlight

Strong and persistent sunlight can cause overheating and damage to the gearbox.

- Protect the gearbox against sunlight using covers or canopies.
- Ensure continuous heat dissipation.

NOTICE

Gearbox damage resulting from violation of the maximum permissible oil sump temperature

Incorrectly adjusted temperature monitoring equipment can permit an excessively high oil sump temperature and cause gearbox damage.

A warning must be output when the maximum permissible oil sump temperature is reached.

- Set the temperature monitoring equipment correctly.
- Ensure the geared motor shuts down when the oil sump temperature is too high.

NOTICE

Damage to shaft sealing rings caused by solvent

If shaft sealing rings come into contact with solvents when preservation coating is removed, the shaft sealing rings can be damaged.

- Avoid contact between solvents and shaft sealing rings.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electrical motor enclosure can reach temperatures that exceed 100 °C. If temperature-sensitive parts, for instance electric cables or electronic components, come into contact with hot surfaces then these parts can be damaged.

- Ensure that no temperature-sensitive parts come into contact with hot surfaces.

4.2 Checklists for assembly

Note

Required checks

The checklists below do not purport to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

Assemble the servo geared motor as described in the following chapters of the operating instructions.

Checklists for assembly

Thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Table 4- 1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Are the environmental conditions in the permissible range?	

Table 4- 2 Checklist (2) - checks regarding the mechanical system

Check	OK
Is the geared motor free of visible damage?	
Have the mounting surfaces (e.g. flange, shaft) on the customer machine and on the geared motor been cleaned?	
Are the mounting surfaces free of corrosion?	
Do the mounting dimensions (e.g. shaft diameter, shaft length, true run) on the customer machine meet the specification?	
Is the supplied mounting paste available for mounting the 1FG1 with hollow shaft or with splined shaft?	
Is the point of power transmission between the customer's hollow shaft and the geared hollow shaft free of grease, mounting paste and other contamination when mounting the 1FG1 with shrink disks or SIMOLOC connection? (See chapter Mounting or removing the hollow shaft with shrink disk (Page 91) orInstalling or removing the SIMOLOC connection (Page 96))	

4.3 Mounting instructions

Note

Technical data on the housing of the servo geared motor

- Comply with the technical data on the rating plates on the housing of the servo geared motor.

- Comply with the data on the rating plate, as well as the warning and information plates on the servo geared motor.
- Check the permissible ambient conditions (e.g. temperature, installation altitude) at the installation location.
- Their use is prohibited in hazardous zones and areas.
- Thoroughly clean the shaft extension of corrosion protection. Use commercially available solvents.
- Ensure sufficient dissipation of heat (see chapter "Cooling (Page 62)").
- If the motor is installed vertically with the end of the shaft facing up, ensure that no liquid can enter the upper bearing.
- After installation, remove the lifting eyes or tighten them.

Tightening torques for fastening bolts

The general tolerance for the tightening torque is 10 %. The tightening torque is based on a friction coefficient of μ = 0.14.

Thread size	Tightening torque at strength class (Nm)		
	8.8	10.9	12.9
M4	3	4	5
M5	6	9	10
M6	10	15	18
M8	25	35	41
M10	50	70	85
M12	90	120	145
M16	210	295	355
M20	450	580	690
M24	750	1000	1200
M30	1 500	2 000	2 400

Tightening torques for screw plugs and valves

The mounting tools to be used are a torque wrench or pneumatic or impact power screwdriver with automatic switch-off.

Pipe thread according to DIN ISO 228 Part1	Tightening torque for brass screws	Tightening torque for ferrous metal screws
	Tolerance +/- 10% (Nm)	Tolerance +/- 12.5% (Nm)
d1	Gearbox cover	Gearbox cover
G 1/8 A	8	10
G 1/4 A	10	10
G 3/8 A	24	35
G 1/2 A	32	-
G 3/4 A	60	85

Tightening torque for screw plugs and valves

Note

The values given in the table "Tightening torque for screw plugs and valves" also apply for all metal valves, e.g. oil drain vales, pressure vent valves.

Plastic vent filters and oil sight glasses must be tightened manually.

4.4 Gearbox with foot mounting

NOTICE

Gearbox damage resulting from impermissible housing loads on uneven installation surfaces

If the gearbox is put under stress when tightening the fixing screws, functional faults and damage to the gearbox can result.

- Ensure a level assembly surface.
  The following degrees of unevenness are the maximum permissible for the gearbox installation surface:
  - For gearboxes up to size 89: 0.1 mm
  - For gearboxes from size 109: 0.2 mm.
- Clean the gearbox installation surface prior to mounting

- Calculate the foundation for the servo geared motor in accordance with the weight and tightening torque. Take account of the forces acting on the gearbox.
- Make sure the foundation for the servo geared motor is free of distortion.
- Build the foundation in such a way that no resonance vibrations are created and no vibrations are transmitted from adjacent foundations.
- If the servo geared motor is fastened to a concrete foundation, use foundation blocks for the appropriate recesses.
- Align and grout the slide rails into the foundation.
- Align the servo geared motor carefully and without offset with the units on the input and output side. Take into account the elastic deformation due to operating forces.
- Prevent displacement from external forces due to lateral impacts.
- Use stud bolts or headless screws of strength class 8.8 or higher for the mounting foot. Observe the tightening torque.

Table 4- 3 Thread size of the fastening bolt

Thread size	Helical gear-boxes D/Z	Parallel shaft gearbox FD/FZ	Bevel gearbox B, K	Helical worm gearbox C
	Size			
M8	29, 39	29, 39	B29, B39	29
M10	-	49	B49, K39, K49	39, 49
M12	49, 59, 69	69, 79	K69, K79	69
M16	79, 89	89	K89	89
M20	-	-	K109	-
M24	129	149	K129	
M30	149	169	K149	
M36	169, 189	189	K169, K189	

4.5 Gearbox with flange fastening

Note

Siemens AG recommends an anaerobic adhesive to enhance the friction lock between flange and mounting surface.

Table 4- 4 Thread size of the fastening bolt

Thread size	Flange	Helical gearboxes D/Z	Parallel shaft gearboxes FD/FZ	Bevel gearbox B, K	Helical worm gearbox C
		Size			
M6	A120	29, 39	29	B29	29
M8	A140, A160	29, 39, 49, 59	29, 39	B29, B39, K39	39
M10	A200	39, 49, 59, 69	49	B39, B49, K49	49, 69
M12	A250, A300	59, 69, 79, 89	69, 79, 89	K69, K79, K89	89
M16	A350	89		K109	-
M16	A450	109, 129, 149, 169	129, 149	K129, K149	-
M16	A550	169, 189	169	K169	-
M20	A660	189	189	K189	-

Use screws / nuts of strength class 8.8 for gearboxes with a flange-mounted design.

Note the following exceptions:

Table 4- 5 Strength class of the fastening bolt for FF/FAF and KF/KAF

Gearbox size	Flange	Strength class for motor size										
		90	100	112	132	160	180	200	225	250	280	315
39	A160	10.9	10.9	-	-	-	-	-	-	-	-	-
49	A200	8.8	10.9	10.9	10.9	-	-	-	-	-	-	-
69	A250	8.8	8.8	8.8	10.9	-	-	-	-	-	-	-
79	A250	8.8	8.8	8.8	10.9	10.9	-	-	-	-	-	-
89	A300	8.8	10.9	10.9	10.9	10.9	10.9	-	-	-	-	-
109	A350	8.8	8.8	8.8	8.8	10.9	10.9	10.9	10.9	-	-	-
129	A450	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	-	-	-
149	A450	-	8.8	8.8	8.8	8.8	8.8	10.9	10.9	10.9	-	-

Table 4- 6 Strength class of the fastening bolt/nut for DZ/ZZ and DF/ZF

Gearbox size	Flange	Strength class
29, 39	A120	10.9 [1)]
49	A140	10.9
59	A160	
69	A200	
79	A250	
89	A300	
109, 129	A350	

1) Use suitable washers under the nuts / bolt heads

4.6 Gearboxes in foot or flange version

NOTICE
Malfunctions or gearbox damage resulting from impermissible housing loads caused by incorrectly installed add-on elements Incorrectly installed add-on elements can cause malfunctions or gearbox damage as a result of impermissible housing loads. Install the add-on elements in such a way that the gearbox is not subjected to stress.

Fasten the gearbox only on the flange or the foot fastening for force and torque transmission.

The second mounting option (foot or flange) is intended for add-on elements that do not transmit any force, e.g. protection covers with an intrinsic weight of up to max. 30% of the weight of the gearbox.

4.7 Mounting an input or output element on the gearbox shaft

NOTICE
Damage to shaft sealing rings caused by heating When mounting input and output elements with the heat treatment, shaft sealing rings can be damaged by overheating. • Use thermal shields to protect shaft sealing rings against overheating above 100 °C due to radiant heat.

Observe the installation or operating instructions during assembly.

Unless otherwise specified, use a torch or a furnace to heat the input and output elements inductively.

Use the center holes in the shaft end faces.

Use a fitting device to fit the input or output elements.

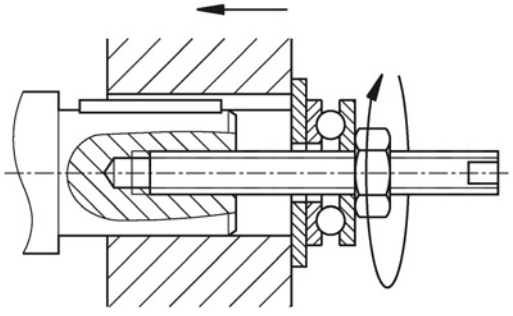
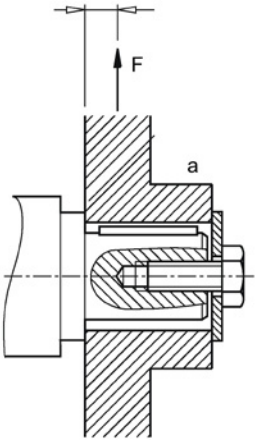
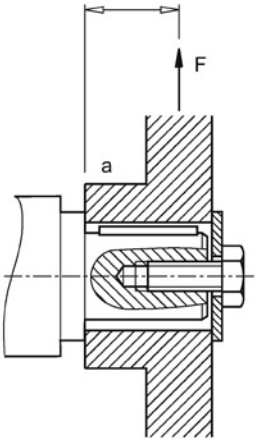


Image 4-1 Example of a fitting device

Assemble the input and output elements in such a way as to minimize the stress on shafts and bearings from transverse forces.

Correct	Incorrect
	
low stress on shafts and bearings	high stress on shafts and bearings

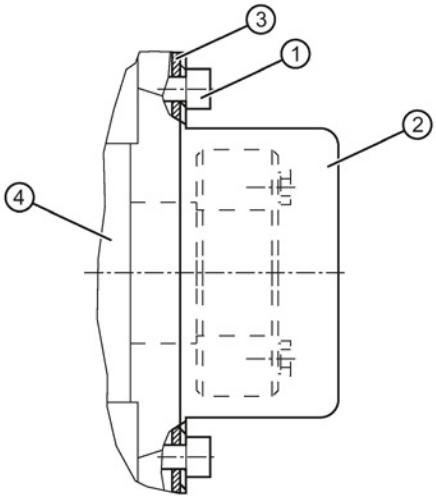
Procedure

1. Use either petrol ether or solvent to remove the anti-corrosion protection from the shaft ends and flanges, or remove the applied protective skin.
2. Heat the input or output elements, if provided
3. Fit the drive input and output elements to the shafts.
4. Secure the input or output elements, if provided.

You have now fitted the input or output element.

4.8 Mounting the protection cover

The protection cover of the hollow shaft is supplied as an assembly kit.



① Screw with washer
② Protection cover
③ Flat seal
④ Gearbox housing

Image 4-2 Mounted protection cover for hollow shaft

Procedure

1. Fit the output shaft.
2. Use a suitable cleaning agent to clean the contact surface of the protection cover ② on the gearbox.
3. Place the flat seal ②.
4. Wet the screws ① with medium-strength adhesive, e.g. Loctite 243.
5. Place the washers on the screws ①.
6. Screw on the protection cover ②.
7. Protect all remaining bare areas with a suitable permanent anti-corrosive agent.

You have now installed the protection cover for operation.

4.9 Installing and removing the shaft-mounted gearbox

NOTICE
Bearing damage due to stress on the hollow shaft A bent or stressed hollow shaft can cause bearing damage. • Mount the gearbox in such a way that the hollow shaft is aligned with the machine shaft. • Mount the hollow shaft without axial and radial stresses.

Note

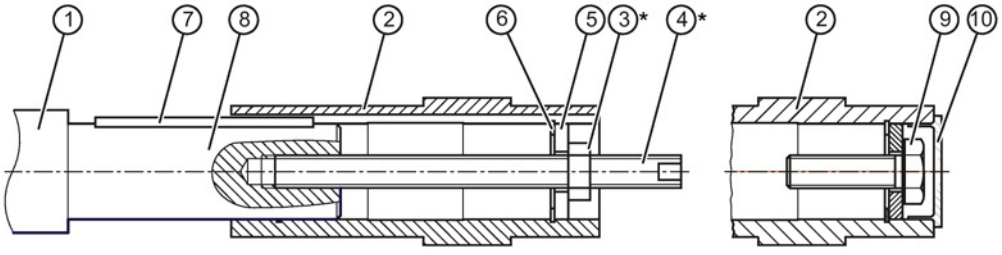
Prevent rusting on the contact surfaces by applying the enclosed mounting paste or a suitable greasing agent.

Note

Observe the permissible concentricity tolerance of the cylindrical shaft end of the machine shaft to the housing axle according to DIN 42955.

4.9.1 Mounting or removing the hollow shaft with feather key

Mounting the hollow shaft with parallel key



①	Machine shaft	⑤	Disk
②	Hollow shaft	⑥	Locking ring
③	Hexagonal nut (* not included in scope of supply)	⑦	Parallel key
④	Threaded spindle (* not included in scope of supply)	⑧	Mounting paste

Image 4-3 Mounting the hollow shaft with parallel key

Instead of the nut and threaded spindle shown in the diagram, other types of equipment such as hydraulic lifting equipment may be used.

Procedure

1. Use petrol ether or a solvent to remove the anti-corrosion protection from the shaft ends and flanges.
2. Check the seats or edges of the hollow and machine shafts for damage.
   Report damage immediately to Technical Support.
3. Apply the enclosed mounting paste ⑦ to the machine shaft ①.
4. Apply the paste uniformly.
5. Fit the gearbox using the disk ⑤, threaded spindle ④ and nut ③.
   Support is provided by the hollow shaft ②.
6. Replace the nut ③ and the threaded spindle ④ with a setscrew.
7. Tighten the bolts to the specified torque.

Table 4- 7 Tightening torque for setscrews

Thread size	M5	M6	M8	M10	M12	M16	M20	M24	M30
Tightening torque [Nm]	5	8	8	14	24	60	120	200	400

You have now mounted the hollow shaft.

Removing the hollow shaft with feather key

⚠ WARNING

Danger to life due to falling gearboxes or geared motors

Falling gearboxes or geared motors during removal can result in death or serious injury.

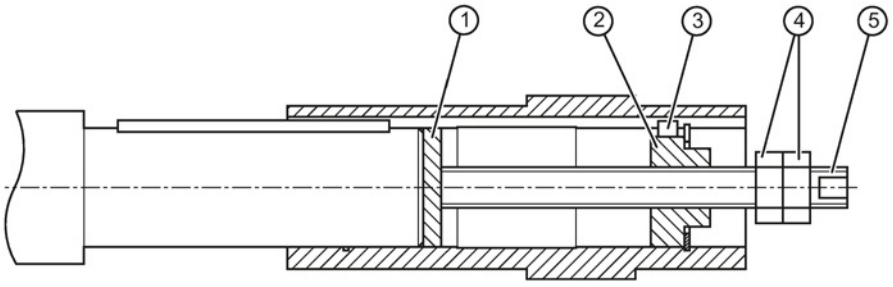
- Before removing, use adequately dimensioned load suspension equipment to secure the gearbox or geared motor against falling.
- Before driving out the machine shaft, fasten adequately dimensioned load suspension equipment to the gearbox.
- Slightly pre-tension the load suspension equipment so that the gearbox does not drop onto it when the plug-in shaft is released.

NOTICE

Damage to bearings and housing through impermissible forces when removing

Excessive forces can occur during removal of the hollow shaft via the housing, and can damage the bearings and housing.

Remove the hollow shaft without placing it under stress or bending it.



Items ① to ⑤ are not included in the scope of supply.

① Disk
② Threaded block
③ Parallel key
④ Hexagon nut
⑤ Threaded spindle

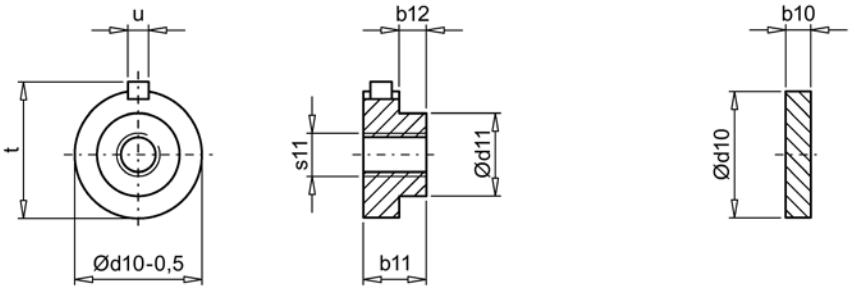
Image 4-4 Removing the hollow shaft with parallel key

Procedure

1. Remove the axial locking element from the hollow shaft.
2. Drive out the machine shaft using the disk ①, threaded block ②, feather key ③, threaded spindle ⑤ and hexagon nuts ④.

You have now removed the hollow shaft with parallel key.

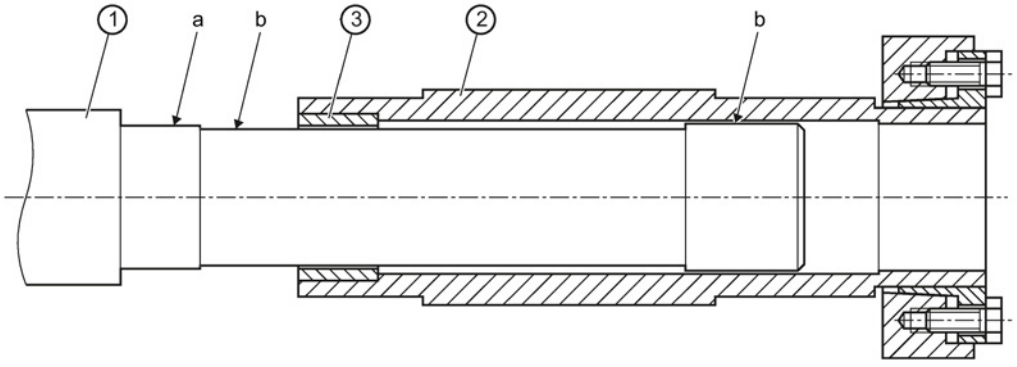
Design suggestion for threaded block and disk



Gearbox	Size	Hollow shaft Ø	b10	b11	b12	d10	d11	s11	t_{max}	u
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
B, C	29	20	3	15	10	19.9	10	M6	22.5	6
B, F	29	25	3	15	10	24.9	16	M10	28	8
C	39	25	3	15	10	24.9	16	M10	28	8
B, K, F, C		30	6	15	10	29.9	18	M10	33	8
B		35	6	15	10	34.9	24	M12	38	10
B		40	6	15	10	39.9	28	M16	43	12
C	49	30	6	15	10	29.9	18	M10	33	8
K, F, C		35	6	15	10	34.9	24	M12	38	10
B		40	6	15	10	39.9	28	M16	43	12
K, F, C	69	40	6	20	9	39.9	28	M16	43	12
C		45	6	20	9	44.9	36	M16	48	14
K, F	79	40	6	20	9	39.9	28	M16	43	12
K, F, C	89	50	7	20	10	49.9	36	M16	53.5	14
C		60	7	20	10	59.9	45	M20	64	18
K, F	109	60	10	24	14	59.9	45	M20	64	18

4.9.2 Mounting or removing the hollow shaft with shrink disk

Mounting the hollow shaft with shrink disk



a Greased
b Absolutely grease-free
① Machine shaft
② Hollow shaft
③ Hexagonal nut (* not included in scope of supply)
④ Threaded spindle (* not included in scope of supply)
⑤ Disk (* not included in scope of supply)
⑧ Bronze bushing

Image 4-5 Mounting the hollow shaft with shrink disk

Instead of the nut and threaded spindle shown in the diagram, other types of equipment such as hydraulic lifting equipment may be used.

Procedure

1. Use petrol ether or a solvent to remove the anti-corrosion protection from the shaft ends and flanges.
2. Check the seats or edges of the hollow and machine shafts for damage.
   Report damage immediately to Technical Support.
3. Fit the gearbox using the disk ⑤, threaded spindle ④ and nut ③.
   Support is provided by the hollow shaft ②.
4. Remove the disk ⑤, threaded spindle ④ and nut ③.

You have now mounted the hollow shaft.

Mounting the shrink disk

NOTICE

Danger of deformation of the hollow shaft caused by tightening the tightening bolts

Tightening the tightening bolts before fitting the machine shaft can cause deformation of the hollow shaft.

1. Install the machine shaft.
2. Tighten the tightening bolts.

NOTICE

Danger of overloading the individual bolts

If the maximum tightening torque is exceeded, this can cause damage to the bolts.

Do not exceed the maximum tightening torque for the tightening bolt.

Note

The shrink disk is delivered ready for installation.

Do not dismantle it before the initial fitting.

Note

The machine shaft material must comply with the following criteria in order to safely and reliably transfer the forces and torques.

Elastic limit Re ≥ 360 N/mm^2

Modulus of elasticity: approx. 206 kN/mm^2

Note

The hollow shaft is axially secured on the machine shaft by means of a shrink disk connection.

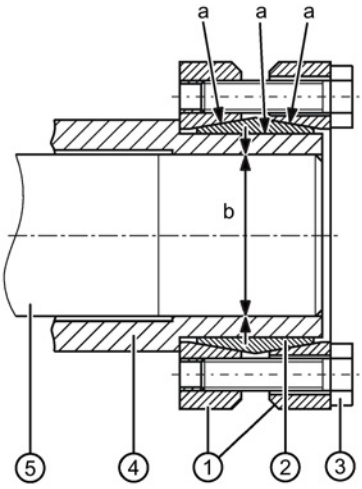
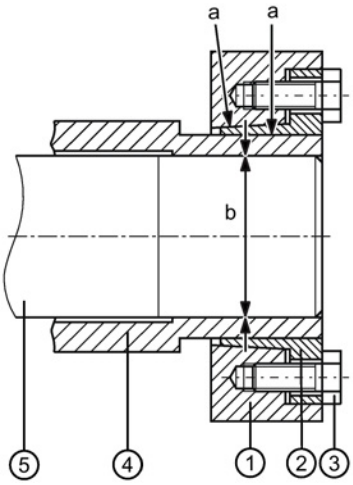
Note

The point of force transmission between the hollow shaft and the machine shaft must be free of greasing agents.

- Cleanse the borehole of the hollow shaft and the machine shaft of grease and other lubricants.
- Do not use impure solvents and soiled cleaning cloths.
- Do not use mounting paste at the point of force transmission between the hollow shaft and the machine shaft.

Note

Apply a thin layer of grease to the shrink disk seat on the hollow shaft.

Sizes 29 - 69:	**Sizes 79 - 149:**
Tighten tightening bolts ③.	The prime importance is that the end faces of the outer ring ① and inner ring ② are flush with one another. If they are not flush with one another when fitting, check the tolerance of the insert shaft.
	

a	Greased
b	Absolutely grease-free
①	Outer ring
②	Inner ring
③	Tightening bolt
④	Hollow shaft
⑤	Machine shaft

Procedure

1. 2.

1. Push the shrink disk onto the hollow shaft.
   - 3-part shrink disk until the limit for sizes 29 - 69.
   - 2-part shrink disk flush with the shaft end for sizes 79 - 149.
2. Tighten the tightening bolts ③ handtight initially.
3. Align the shrink disk so that the clamping flanges are plane-parallel with each other.
4. Use the torque wrench to turn each of the clamping screws ③ equally by 1/6 revolution (not crosswise), repeating this procedure several times. Do not exceed the maximum tightening torque.
5. Attach the rubber cover or protection cover included in the scope of supply, see Mounting the protection cover (Page 86).

You have now installed the shrink disk.

Table 4- 8 Tightening torque for the tightening bolt

Gearbox size	Thread size	Strength class	Tightening torque
			[Nm]
29	M5	8.8	5
39, 49, 69	M6	8.8	12
79, 89	M8	12.9	35
109, 129	M10	12.9	70
149	M10	12.9	121

Pulling off the shrink disk

Procedure

1. Release the tightening bolts ③ one after the other by a ¼ turn each time using a wrench successively.
   Do not completely remove the bolts.
2. Pull the shrink disk off the hollow shaft.

Note

Sizes 79 - 149:
If the outer ring does not come away from the inner ring, insert some of the tightening bolts into neighboring forcing threads.

Pull the shrink disk off the hollow shaft.

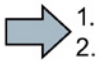
Cleaning and lubricating shrink disks

Note

Soiled shrink disks must be cleaned and re-greased prior to fitting

Loosened shrink disks need not be dismantled and re-greased before being refitted.

Procedure



1. Only grease the inner friction surfaces of the shrink disks. To do this, use a solid lubricant with a friction coefficient of μ = 0.04.
2. Use a paste containing MoS_2 to grease the bolts, applying the paste to the thread and underneath the head.

Clean the shrink disk.

Table 4- 9 Lubricants for shrink disks

Lubricant	Sold as	Manufacturer
Molykote 321 R (lubricant paint)	Spray	DOW Corning
Molykote spray (powder spray)		
Molykote G Rapid	Spray or paste	
Molykombin UMFT 1	Spray	Klüber Lubrication
Unimily P5	Powder	
Aemasol MO 19 P	Spray or paste	A. C. Matthes

4.9.3 Installing or removing the SIMOLOC connection

NOTICE
Danger of overloading the individual bolts.
If the maximum tightening torque is exceeded, this can cause damage to bolts ④ and ⑩.
Do not exceed the maximum tightening torque for tightening bolts ④ and ⑩.

Note

The point of force transmission between the hollow shaft and the machine shaft must be free of greasing agents.

- Cleanse the borehole of the hollow shaft and the machine shaft of grease and other lubricants.
- Do not use impure solvents and soiled cleaning cloths.
- Do not use mounting paste at the point of force transmission between the hollow shaft and the machine shaft.

Note

The SIMOLOC connection fastens the hollow shaft axially on the machine shaft.

Note

Oil the locating hole for the tapered bushing ⑨ and bronze bushing ② in the hollow shaft ⑥ lightly with the provided oil.

Type of the provided oil: CLP VG 68 DIN 51517-3

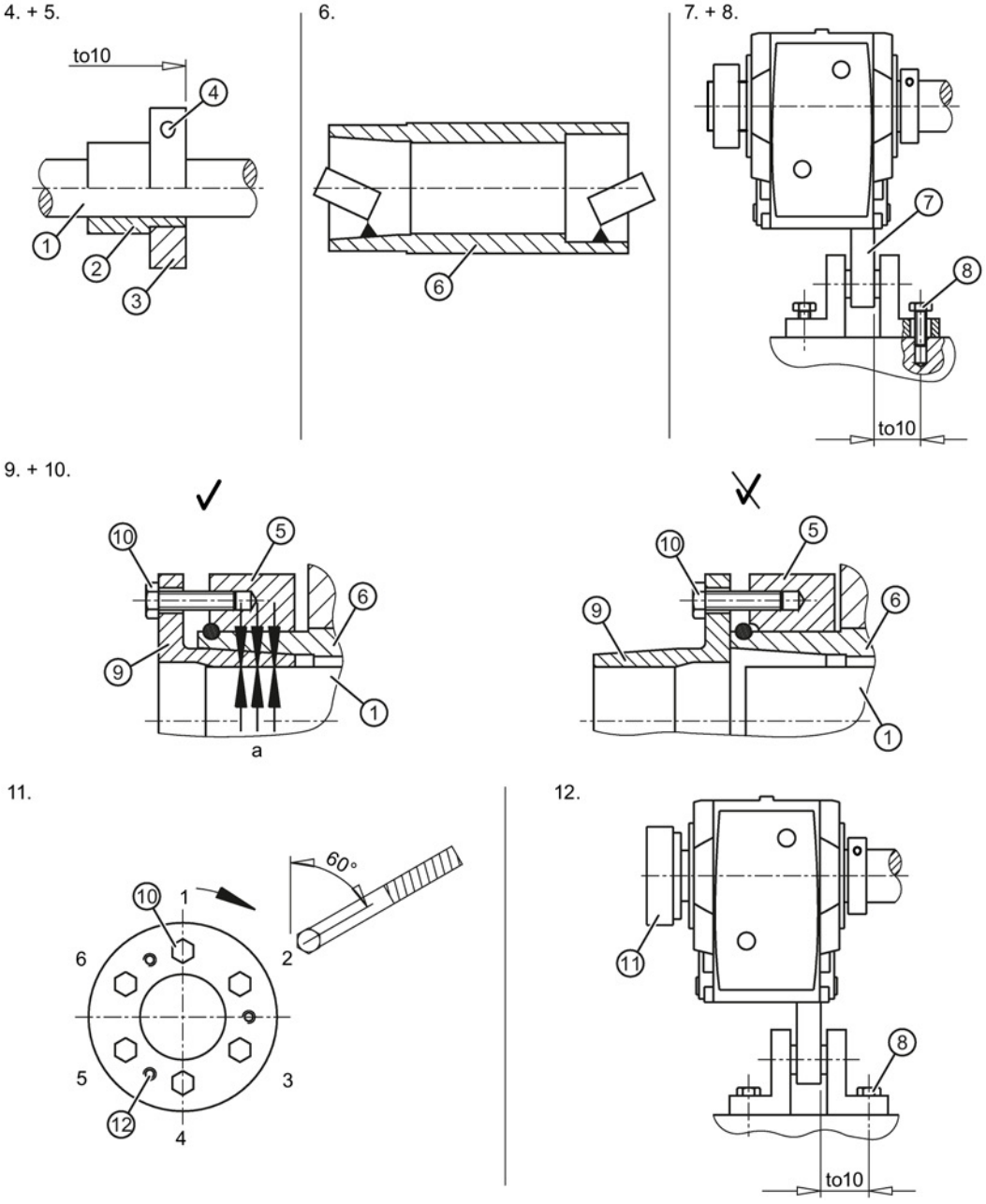
Note

Place the thrust collar ⑤ at the correct position as in the delivery state.

Note

Before installing the SIMOLOC, mount the torque arms ⑦ on the gearbox.

Installing the SIMOLOC connection



a Absolutely grease-free
① Machine shaft
② Bronze bushing
③ Clamping ring
④ Tightening bolt for the clamping ring
⑤ Thrust collar
⑥ Hollow shaft
⑦ Torque arm
⑧ Bolt
⑨ Tapered bushing
⑩ Tightening bolt for the tapered bushing
⑪ Protection cover / cover cap
⑫ Threaded hole for the tightening bolt ⑩ during disassembly

Image 4-6 Installing the SIMOLOC connection

Procedure

1.
2.

1. Attach the torque arm ⑦ to the gearbox. See Torque arms with shaft-mounted gearboxes (Page 102)
2. Remove the corrosion protection coating using white spirit or a solvent:
   – The shaft ends of the machine shaft ①
   – The clamping ring ③
   – The bronze bushing ②.
3. Check the seats or edges of the hollow shaft ⑥ and the machine shaft ① for damage. Report damage immediately to Technical Support.
4. Place the clamping ring ③ on the bronze bushing ②.
5. Position the bronze bushing ② with the clamping ring ③ on the machine shaft ①. Observe the tightening torque of the tightening bolt ④ and the tolerance dimension to10.
6. Oil lightly the locating holes in the hollow shaft ⑥ for the tapered bushing ⑨ and bronze bushing ②.
   Remove any excessive oil using a clean cloth.
7. Push the gearbox with the installed torque arm ⑦ on the machine shaft ① against the clamping ring ③.
8. Tighten the torque arm ⑦ with the bolts ⑧ only gently because the gearbox must have clearance for the subsequent mounting.
9. Place the thrust collar ⑤ at the correct position.
   If the thrust collar ⑤ is not located at the correct position, bring it ⑤ into the correct position by tightening the tightening bolts ⑩ with turned tapered bushing ⑨.
10. Place the tapered bushing ⑨ on the machine shaft ①.
11. Use the torque wrench to turn each of the tightening bolts ⑩ equally (not crosswise), repeating this procedure several times. Do not exceed the maximum tightening torque for tightening bolt ⑩.

12. Tighten the bolts ⑧ of the torque-arm fastening. See Torque arms with shaft-mounted gearboxes (Page 102)
13. Attach the rubber cover or protection cover ⑪ included in the scope of delivery. See Mounting the protection cover (Page 86)

☐ You have attached the SIMOLOC connection.

Table 4- 10 Tolerance dimension, tightening bolt ④ tightening torque

Gearbox type	Size	Tolerance dimension to10	Thread size ④	Tightening torque
		[mm]	Strength class 8.8	[Nm]
F, B, C	29	0.6 ... 2.1	M6	10
F, B, K, C	39	0.7 ... 2.2		
F, B, K, C	49	0.8 ... 2.6		
F, K, C	69	0.7 ... 2.5	M8	25
F, K	79	1.4 ... 3.2		
F, K, C	89	1.5 ... 3.4		

Table 4- 11 Tightening bolt ⑩ tightening torque

Gearbox type	Size	Thread size ⑩	Tightening torque
		Strength class 12.9	[Nm]
F, B, C	29	M5	10
F, B, K, C	39		
F, B, K, C	49	M6	16
F, K, C	69		
F, K	79	M8	38
F, K, C	89		

Removing the SIMOLOC connection

⚠ WARNING

Danger to life due to falling gearboxes or geared motors

Falling gearboxes or geared motors during removal can result in death or serious injury.

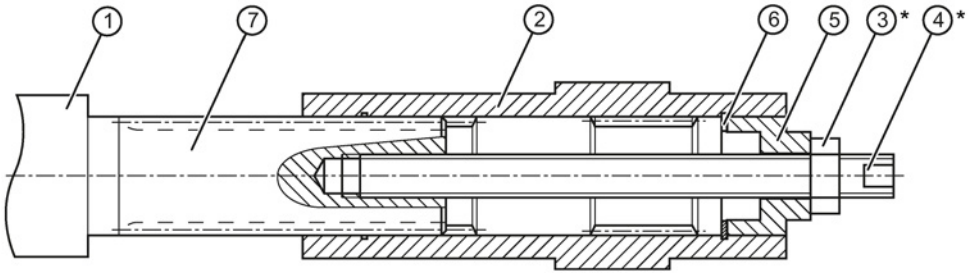
- Before removing, use adequately dimensioned load suspension equipment to secure the gearbox or geared motor against falling.
- Slightly pre-tension the load suspension equipment so that the gearbox does not drop onto it when the machine shaft is released.

Procedure

1. Remove all bolts ⑩.
2. Unscrew the bolts completely.
3. Screw the bolts ⑩ into the threaded holes ⑫.
4. Use the torque wrench to turn each of the bolts ⑩ equally (not crosswise), repeating this procedure several times. Do not exceed the maximum tightening torque for bolt ⑩. Repeat the task until the tapered bushing ⑨ has been freed.
5. Remove the bolts ①.
6. Remove the tapered bushing ⑨.
7. Lower the gearbox from the machine shaft ①.

You have removed the SIMOLOC connection.

4.9.4 Mounting the hollow shaft with splines



* Not included in scope of supply
① Machine shaft
② Hollow shaft
③ Hexagon nut
④ Threaded spindle
⑤ Disk
⑥ Locking ring
⑦ Mounting paste

Image 4-7 Mounting the hollow shaft with splines

Instead of the nut and threaded spindle shown in the diagram, you can also use hydraulic lifting equipment.

Procedure

1. Use petrol ether or a solvent to remove the anti-corrosion protection from the shaft ends and flanges.
2. Check the seats or edges of the hollow and machine shafts for damage.
   Report damage immediately to Technical Support.
3. Apply the mounting paste ⑦ to the machine shaft ①.
   Apply the paste uniformly.
4. Fit the gearbox using the disk ⑤, threaded spindle ④ and nut ③.
   The hollow shaft ② supports the gearbox.
5. Replace the nut ③ and the threaded spindle ④ with a setscrew.
   Tighten the bolts with the specified torque.

You have now mounted the hollow shaft.

Table 4- 12 Tightening torque for setscrews

Thread size	M5	M6	M8	M10	M12	M16	M20	M24	M30
Tightening torque [Nm]	5	8	8	14	24	60	120	200	400

4.9.5 Torque arms with shaft-mounted gearboxes

Torque arms can absorb the reaction torque and the weight force of the gearbox.

NOTICE
Danger of machine damage due to excess backlash Excessive backlash of the torque arm can cause hazardous torque surges and thus machine damage. • Mount the torque arm in such a way that excessively high constraining forces do not occur, e.g. due to the driven shaft running out-of-true.

NOTICE
Danger of gearbox damage due to impermissible stress on the gearbox resulting from incorrect installation Incorrect installation of the torque arm can cause stress on the gearbox housing and thus damage to the gearbox. • Mount the torque arm so that it is free of stress.

NOTICE
Risk of damage to the rubber elements caused by solvents Solvents, oils, greases, and fuels damage rubber elements. • Avoid bringing the rubber elements into contact with solvents, oils, greases, and fuels.

Mounting torque arms on parallel shaft gearboxes

We recommend using pretensioned, damping rubber elements.

Fixing accessories such as brackets, bolts, nuts, etc., are not included in the scope of supply.

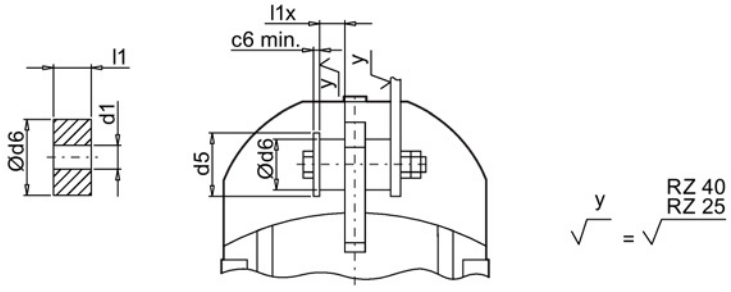


Image 4-8 Mounting suggestion for torque arms on F.29 - F.149

Size	Rubber buffer				Washer	
	Untensioned	Tensioned				
	l1	l1x	d6	d1	d5	$c6_{min}$
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
29	15	14.0	30	10.5	40	4
39		13.5				
49	20	18.5	40	12.5	50	6
69		18.5				
79		17.5				
89	30	28	60	21	75	8
109		27.5				
129	40	37.5	80	25	100	10
149		36.5				

Procedure

1. Use the washers according to the table above.
2. Use two nuts to secure the screw connection (lock nuts).
3. Tighten the screws until the rubber buffers are pretensioned to the dimension l1x.

You have now mounted the torque arm.

Mounting torque arms on bevel gearboxes and helical worm gearboxes

NOTICE
Risk of machine damage due to excessive stress resulting from incorrect installation
Incorrect installation of the torque arm can cause stress on the gearbox housing and thus damage to the machine.
Mount the torque arm bushing so that it is supported by bearings on both sides.

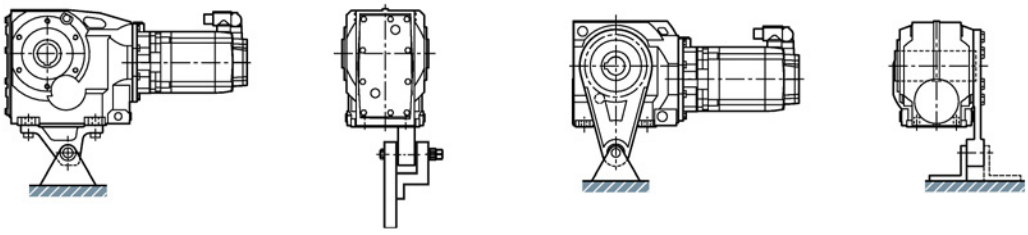


Image 4-9 Mounting suggestion for torque arm on foot and flange

The torque arm can be fitted in various positions, depending on the hole circle pitch.

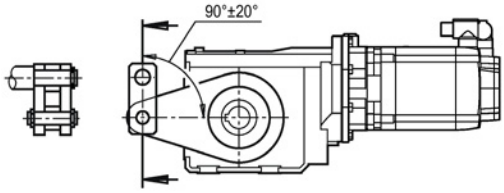


Image 4-10 Toggle lever design

For a toggle lever design, derive the force in the range of 90° ±20°.

Procedure

1. Clean the contact surfaces between the housing and the torque arm.
2. Tighten the bolts to the specified torque.

You have now mounted the torque arm.

Table 4- 13 Tightening torque for screws of strength class 8.8

Thread size	M8	M10	M12	M16	M20	M24	M36
Tightening torque [Nm]	25	50	90	210	450	750	2 600

4.10 Mount the oil expansion unit

The oil expansion unit equalizes changes in the oil volume caused by temperature fluctuations in operation.

The oil expansion unit is required

- at high input speeds
- in mounting position M4 (motor top)

The size of the supplied oil expansion unit depends on the gearbox.

Unit size	Size 1	Size 2
Unit volume	0.05 l	1.5 l
Gearbox size	FZ 39 - 89 K 39 - 109 B 39 - 49 C 69 - 89	FZ.129 K 129 - 149

Note

Selecting the oil expansion unit

Contact the Siemens Service Center for final selection of the oil expansion unit.

The unit is supplied as a mounting kit.

Note

Attaching the oil expansion unit before commissioning

Before commissioning the gearbox, replace the pressure vent valve that is already installed with the provided oil expansion unit.

Installing the oil expansion unit size 1

Procedure

Note

Prevent the ingress of contamination and corrosive atmosphere into the gearbox when unscrewing the vent valve.

1. Completely unscrew the pressure vent valve with transport fixture.
2. Screw in the completely preassembled oil expansion unit.
3. Align the oil expansion unit so that it is in a vertical position.

☐ You have now installed the oil expansion unit.

Note

Replace the vent valve of the unit yearly.

Installing the oil expansion unit size 2

You can fasten the oil expansion unit at 4 positions on the geared motor.

We recommend position 1 or position 2.

When you secure the unit on your installation, start with step 4 of the procedure. The supplied hose is 1 m long.

Procedure

1. Remove the two 1210 screws from position 1, position 2, position 3 or position 4. The screws are no longer required.
2. Screw base plate 1452 with the 1453 screws and the 1454 washers to the gear unit. Tightening torque for M12 screw 1453: 90 Nm. Tightening torque for M16 screw 1453: 210 Nm.
3. Fasten bracket 1455 with the screws 1456, locking nuts 1458 and washers 1457 to base plate 1452.
   Tightening torque for screw 1456: 25 Nm.
   Use the elongated hole to adjust the distance from the oil expansion unit to the motor.
4. Screw pressure relief valve 1420 into tank 1451 with 35 Nm torque.
5. Fasten tank 1451 with clips 1459 to bracket 1455 or at an appropriate location on the unit. Ensure that pressure relief valve 1420 points upwards.
6. Screw reduction piece 1460 with 35 Nm torque onto the lower side of tank 1451.
7. Press one end of hose 1463 onto angular hose nozzle 1461.
8. Fix hose end 1463 with clip 1462.

9. Screw angular hose nozzle 1461 onto reduction piece 1460.
   Do not tighten the parts yet. Orientate hose 1463 roughly in the direction of the connection hole.
10. Replace screw plug 1401 with reduction piece 1466.
    Screw plug 1401 is no longer required.
    Tightening torque for reduction piece 1466 G 3/8": 35 Nm
    Tightening torque for reduction piece 1466 size 3/4": 85 Nm
11. Screw angular hose nozzle 1464 temporarily onto reduction piece 1466.
12. Shorten hose 1463 to the required length.

Note

Determining the hose length

Hose 1463 must have a negative gradient from tank 1451 to the connection hole.

Hose 1463 must not form a siphon.

13. Loosen angular hose nozzle 1464 and press on the free hose end.
14. Fix hose end 1463 with clip 1465.
15. Screw angular hose nozzle 1464 with 35 Nm tightening torque onto reduction piece 1466.
16. Tighten angular hose nozzle 1461 with a torque of 35 Nm.

☐ You have now installed the oil expansion unit.

Note

Replace the vent valve of the unit yearly.

Connecting

5

5.1 Safety instructions

⚠ DANGER

Danger to life due to live parts and other energy sources

Death or serious injury can result when live parts are touched.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, six steps apply when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the supply.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.
   - Check whether the existing auxiliary supply circuits are de-energized.
   - Ensure that the motors cannot move.
3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water.
4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
5. Secure the energy sources against switching on again.
6. Ensure that the correct machine is completely interlocked.

After you have completed the work, restore the operational readiness in the inverse sequence.

5.2 Circuit diagram

The circuit diagram contains information about wiring and connecting the motor winding.

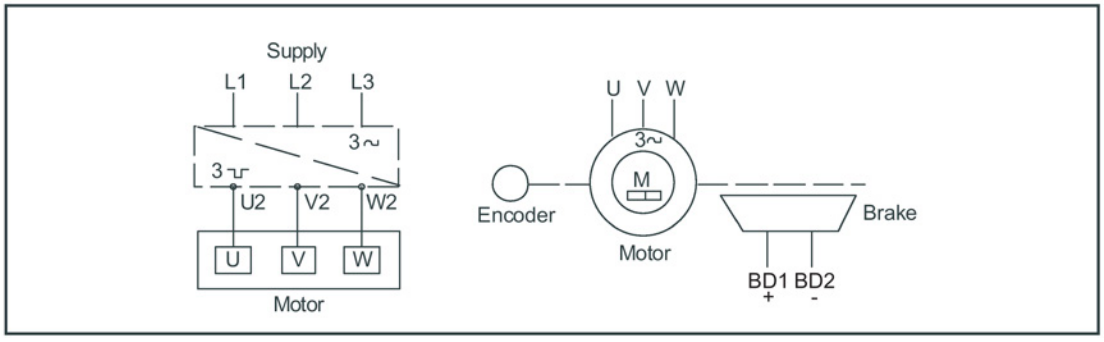


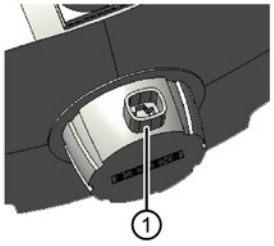
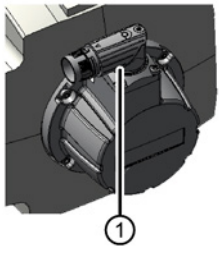
Image 5-1 Circuit diagram

5.3 Motors with DRIVE-CLiQ interface

Motors designed for SINAMICS drive systems have an integrated encoder and temperature evaluation system as well as an electronic rating plate.

The motors are connected to the converter system via a DRIVE-CLiQ interface.

We recommend the following two variants for the DRIVE-CLiQ connection:

10-way RJ45plus socket	Round connector M17
	
1 10-way RJ45plus socket	1 round connector M17

The DRIVE-CLiQ interface supplies the motor encoder with power via the integrated 24-V-DC power supply. The DRIVE-CLiQ interface transfers the motor encoder and temperature signals and the electronic rating plate data, e.g. a unique identification number, rating data (voltage, current, torque) to the Control Unit.

Motors with a DRIVE-CLiQ interface can be connected to the associated Motor Module via a MOTION-CONNECT cable. The connection of the MOTION-CONNECT cable at the motor has degree of protection IP67.

NOTICE
Damage to electronic components as a result of electrostatic discharge
The Sensor Module has direct contact with electrostatic sensitive devices that can be damaged or destroyed by electrostatic discharge (ESD). • Ensure the ESD protection measures are taken (see Handling electrostatic sensitive devices (ESD) (Page 18)). • Only grounded personnel with grounded tools may touch the component connections. • Heed the EMC information provided by the manufacturer of the inverter.

The motor and the Motor Module are connected via a MOTION-CONNECT cable, see Instructions for handling the RJ45_1FT7 connector (Page 112)

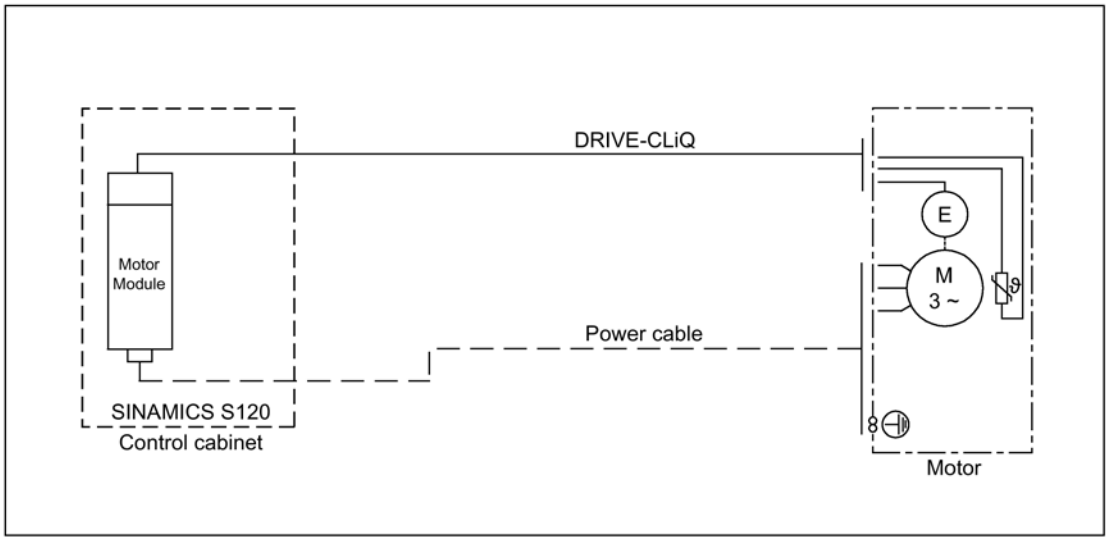
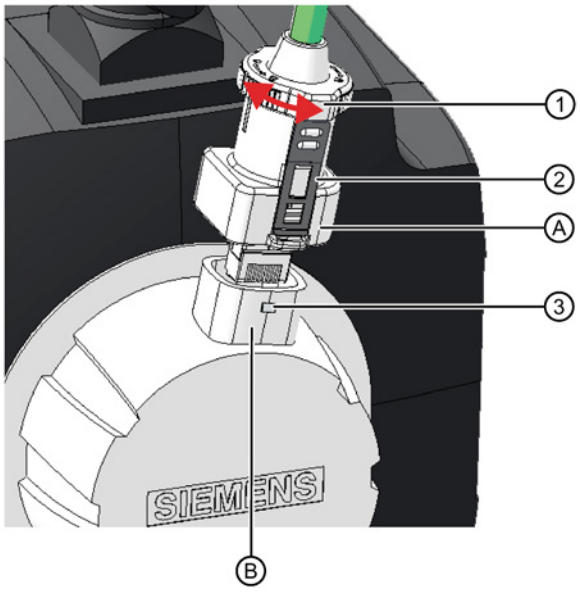


Image 5-2 Encoder interface with DRIVE-CLiQ

5.4 Instructions for handling the RJ45_1FT7 connector

The DRIVE-CLiQ connection method with the RJ45 connector has the following components:



A	DRIVE-CLiQ plug with RJ45 plug
B	DRIVE-CLiQ socket with RJ45 socket
1	Rotatable locking ring
2	Tabs (2, opposite each other)
3	Latches (2, opposite each other)

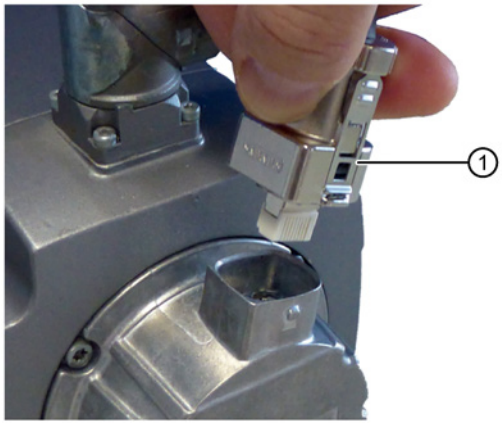
Insertion

1.
2.

1. Check whether the locking ring of the connector is in the "locked" position.
   If not, turn the locking ring clockwise into the "locked" position.

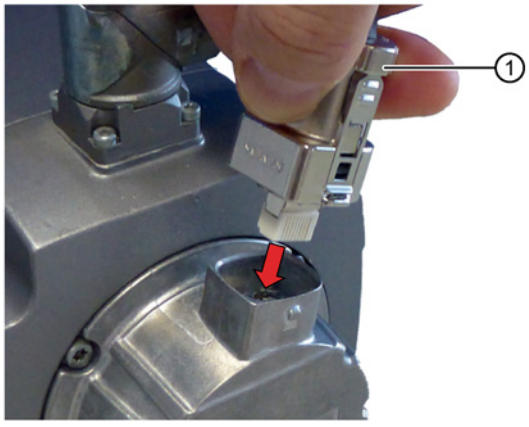
Note

In the "locked" position, the tabs are flush against the connector.



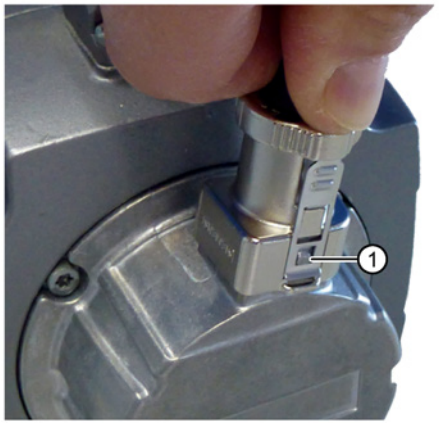
1 Locking ring in the "locked" position

2. Insert the connector into the RJ45 socket of the Sensor Module.

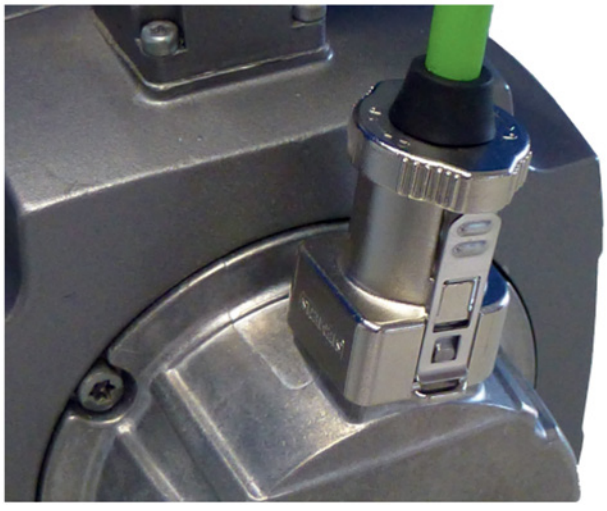


1 The locking ring remains in the "locked" position.

3. Check that the two tabs are engaged in both latches on the socket and that the connector cannot be pulled out.



1 Both tabs must engage in both latches.



The correct DRIVE-CLiQ connection is made when

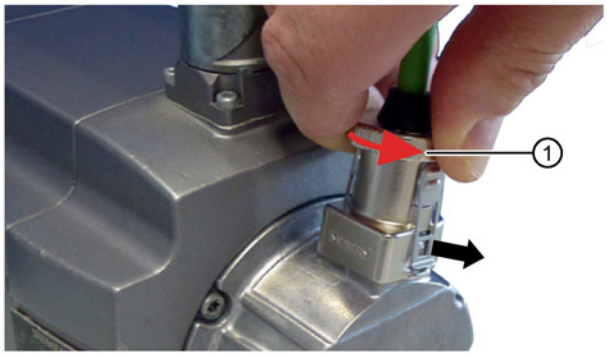
- the locking ring is in the "locked" position,
- both tabs are engaged in both latches.

☐ You have made a DRIVE-CLiQ connection.

Removal

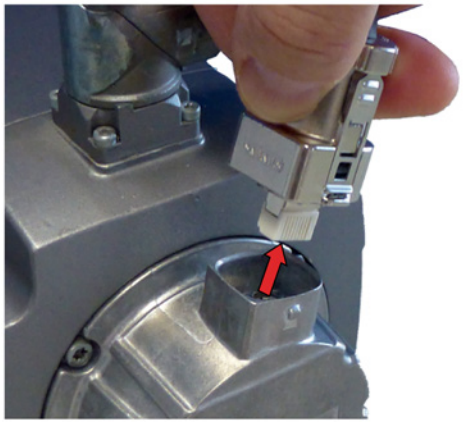
1.
2.

1. Turn the locking ring of the connector counterclockwise into the "unlocked" position.



1 Turn the locking ring counterclockwise.
→ Both tabs are pressed away by the latches.

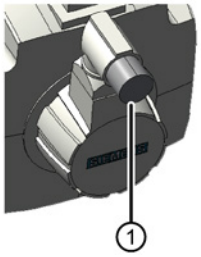
2. Check that the two tabs are disengaged from the latches.
3. Pull the connector out of the RJ45 socket of the Sensor Module.



You have released the DRIVE-CLiQ connection.

5.5 Motors without a DRIVE-CLiQ interface

If a motor is not equipped with a DRIVE-CLiQ interface, the speed encoder and temperature sensor are connected via a signal connector.



1 Signal connector

Image 5-3 Motor with a signal connector

Motors without DRIVE-CLiQ require a Sensor Module Cabinet (SMC) for operation with a SINAMICS S120 drive system. The motor is connected to the SMC via a signal cable. The SMC is connected to the motor via a MOTION-CONNECT cable.

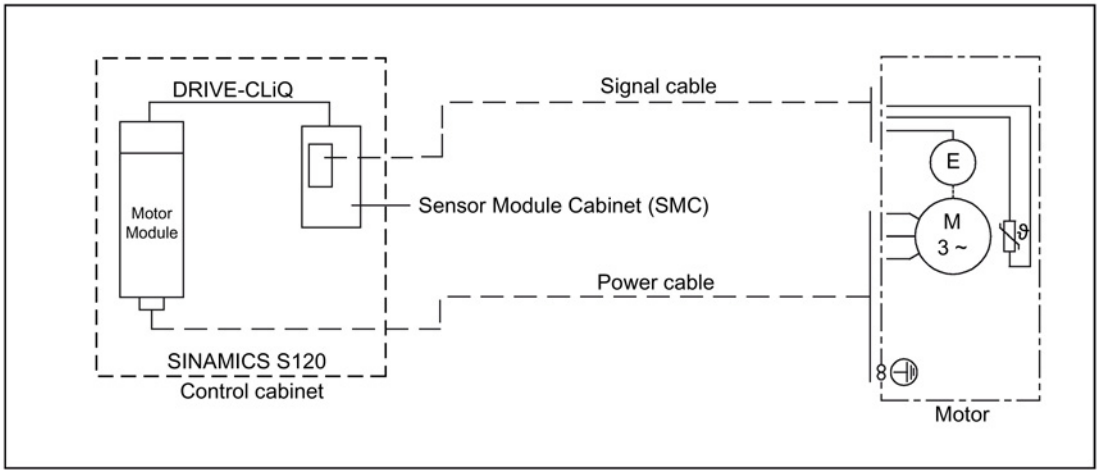


Image 5-4 Encoder interface without DRIVE-CLiQ

5.6 Motor connection

NOTICE
Destruction of the motor if it is directly connected to the three-phase line supply
The motor will be destroyed if it is directly connected to the three-phase line supply. • Only operate the motors with the appropriately configured inverters.

NOTICE
Damage to electronic components as a result of electrostatic discharge
Electrostatically sensitive devices (ESD) can be damaged or destroyed by electrostatic discharge. • Observe the ESD protection measures. • Only grounded personnel with grounded tools may touch the component connections. • Heed the EMC information provided by the manufacturer of the inverter.

- Use prefabricated cables from SIEMENS (not in the scope of delivery). These cables reduce installation costs and increase operational reliability (see the Product Information).
- The manufacturer of the plant/machine is responsible for the ensuring that installation is performed correctly and professionally.
- Observe the data on the rating plate and the circuit diagrams.
- Adapt the connecting cables to the type of use and the voltages and currents that occur.
- When fed from a converter, high-frequency current and voltage oscillations in the motor feeder cables can cause electromagnetic interference. Therefore, use shielded power cables.
- Heed the EMC information provided by the manufacturer of the inverter.
- Make sure that the inside of the connector is clean and free of cable cuttings and moisture.
- Avoid protruding wire ends.
- Check that the degree of protection is complied with at the seals and sealing surfaces of the connectors.
- Secure connecting cables against torsion, tensile and compressive strain, and protect them against kinking. It is not permissible to subject the connector to continuous force.
- Insert the coding groove of the plug-in connection into the socket until flush and tighten the screw cap by hand in as far as it will go.

Current-carrying capacity for power and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2, C and E under continuous operating conditions in the table. The current-carrying capacity is specified for an ambient air temperature of 40 °C. For other ambient temperatures, the values must be corrected by the factors from the Table "Derating factors".

Table 5- 1 Cable cross section and current-carrying capacity

Cross section	Current-carrying capacity, AC 50/60 Hz or DC for routing type			
[mm²]	B1 [A]	B2 [A]	C [A]	E [A]
Electronics (according to EN 60204-1)				
0.20	-	4.3	4.4	4.4
0.50	-	7.5	7.5	7.8
0.75	-	9	9.5	10
Power (according to EN 60204-1)				
0.75	8.6	8.5	9.8	10.4
1.00	10.3	10.1	11.7	12.4
1.50	13.5	13.1	15.2	16.1
2.50	18.3	17.4	21	22
4	24	23	28	30
6	31	30	36	37
10	44	40	50	52
16	59	54	66	70
25	77	70	84	88
35	96	86	104	110
50	117	103	125	133
70	149	130	160	171
95	180	165	194	207
120	208	179	225	240
Power (according to IEC 60364-5-52)				
150	239[1)]	206[1)]	259[1)]	276[1)]
185	274[1)]	235[1)]	296[1)]	315[1)]
> 185	Consult the standard for the values.			

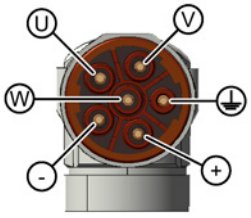
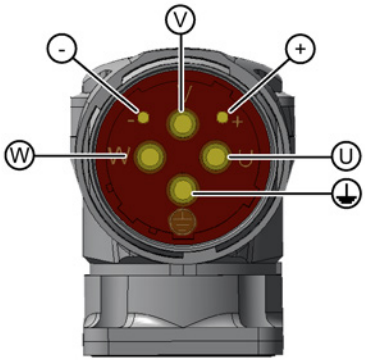
[1)] Extrapolated values

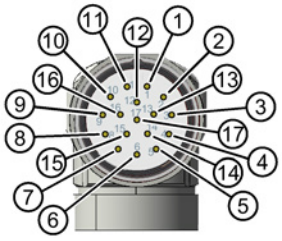
Table 5- 2 Derating factors for power and signal cables

Ambient air temperature [°C]	Derating factor according to EN 60204-1, Table D1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

Connector types

Table 5- 3 Power connection

Connector size 1	Connector size 1.5
	
+ = BD1+; - = BD2-	+ = BD1+; - = BD2-

Pin assignment, 12-pin signal connector	**Pin assignment, 17-pin signal connector**	
		
Resolver	Incremental encoder sin/cos 1 Vpp	Absolute value encoders
1 = S2	1 = A	1 = A
2 = S4	2 = A*	2 = A*
3 = not connected	3 = R	3 = data
4 = not connected	4 = D*	4 = not connected
5 = not connected	5 = C	5 = clock
6 = not connected*	6 = C*	6 = not connected
7 = R2	7 = M encoder	7 = M encoder
8 = +1R1	8 = +1R1	8 = +1R1
9 = -1R2	9 = -1R2	9 = -1R2
10 = R1	10 = P encoder	10 = P encoder
11 = S1	11 = B	11 = B
12 = S3	12 = B*	12 = B*
	13 = R*	13 = data*
	14 = D	14 = clock*
	15 = M sense	15 = M sense
	16 = P sense	16 = P sense
	17 = not connected	17 = not connected

5.7 Rotating the connector at the motor

Power connectors and signal connectors can be rotated to a limited extent.

Use a suitable socket connector to rotate the angle plug.

Unscrew and open the socket connector completely to avoid damaging the pin contacts.

For encoders with integrated Sensor Modules (DQI) the cable outlet towards the top is fixed and cannot be changed.

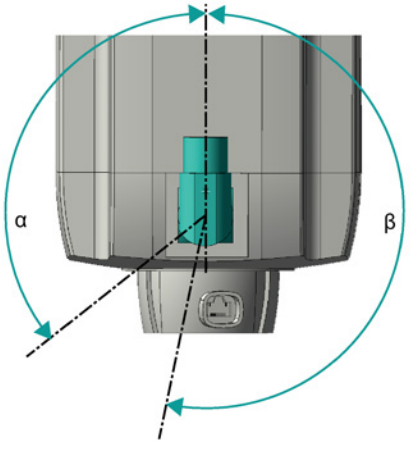
Note

Rotating the connectors

- Do not exceed the permissible range of rotation.
- To ensure the degree of protection, do not rotate more than 10 times.
- Rotate the connector using a mating connector that matches the connector thread. Rotate sensor modules by hand only. Use of tools is not permissible.

Ability to rotate the power connector on motors with DRIVE-CLiQ interface 1FG1□□□-□□X□□-□□□□; X = C, D, E, F, G

Table 5- 4 Rotation range of the power connector

Motor	Angle α	Angle β	Connector size	Drawing
1FG1□□□-□□C□□	122°	208°	1	
1FG1□□□-□□D□□ 1FG1□□□-□□E□□ 1FG1□□□-□□F□□ 1FG1□□□-□□G□□	135°	195°	1	
1FG1□□□-□□F□□ 1FG1□□□-□□G□□	195°	140°	1.5	

Ability to rotate the connectors on motors without a DRIVE-CLiQ interface and on motors with a DRIVE-CLiQ interface via Sensor Modules 1FG1□□□-□□X□□-□□□□; X = C, D, E,F,G

Table 5- 5 Rotation range of the power connector

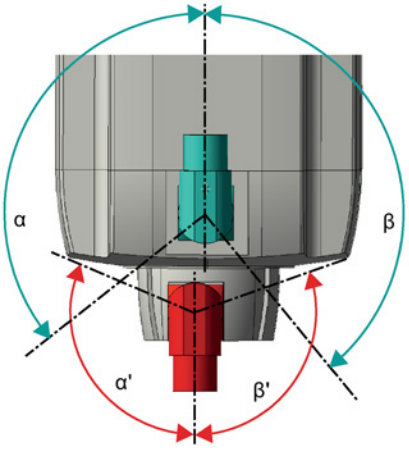
Motor	Angle α	Angle β	Connector size	Drawing
1FG1□□□-□□C□□	122°	158°	1	
1FG1□□□-□□D□□ 1FG1□□□-□□E□□ 1FG1□□□-□□F□□	135°	140°	1	
1FG1□□□-□□G□□	135°	195°	1	
1FG1□□□-□□F□□ 1FG1□□□-□□G□□	195°	140°	1.5	

Table 5- 6 Rotation range of the signal connector

Motor	with DRIVE-CLiQ via Sensor Module		connector without DRIVE-CLiQ		Drawing
	Angle α´	Angle β´	Angle α´	Angle β´	
1FG1□□□-□□C□□	130°	120°	160°	135°	See Table, "Power connectors"
1FG1□□□-□□D□□	145°	135°	145°	135°	
1FG1□□□-□□E□□	110°	110°	150°	135°	
1FG1□□□-□□F□□ 1FG1□□□-□□G□□	90°	90°	90°	90°	

Table 5- 7 Max. torque when rotating

Connectors	Max. torque when rotating
Power connector, size 1	12 Nm
Power connector, size 1.5	20 Nm
Signal connector (without DRIVE-CLiQ)	12 Nm
Signal connector (with DRIVE-CLiQ)	8 Nm

5.8 Connecting-up a converter

Selecting and connecting the cables

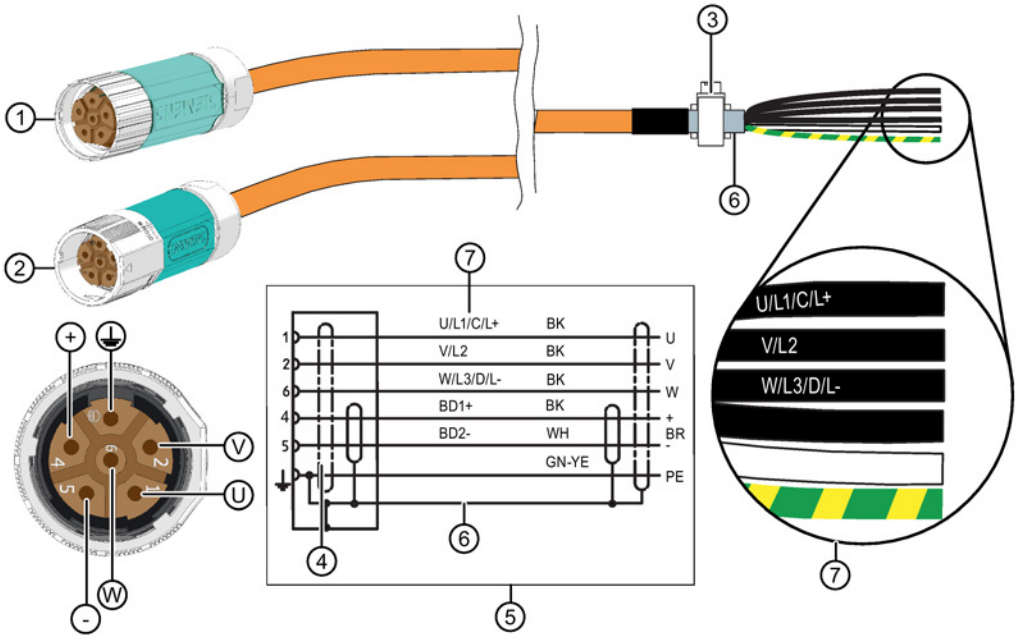
- To connect the motor to a converter, use MOTION-CONNECT cables or shielded connecting cables.

Note

The cable shielding, made up of as many strands as possible, must have a high electrical conductivity. Braided shields made of copper or aluminum are well suited.

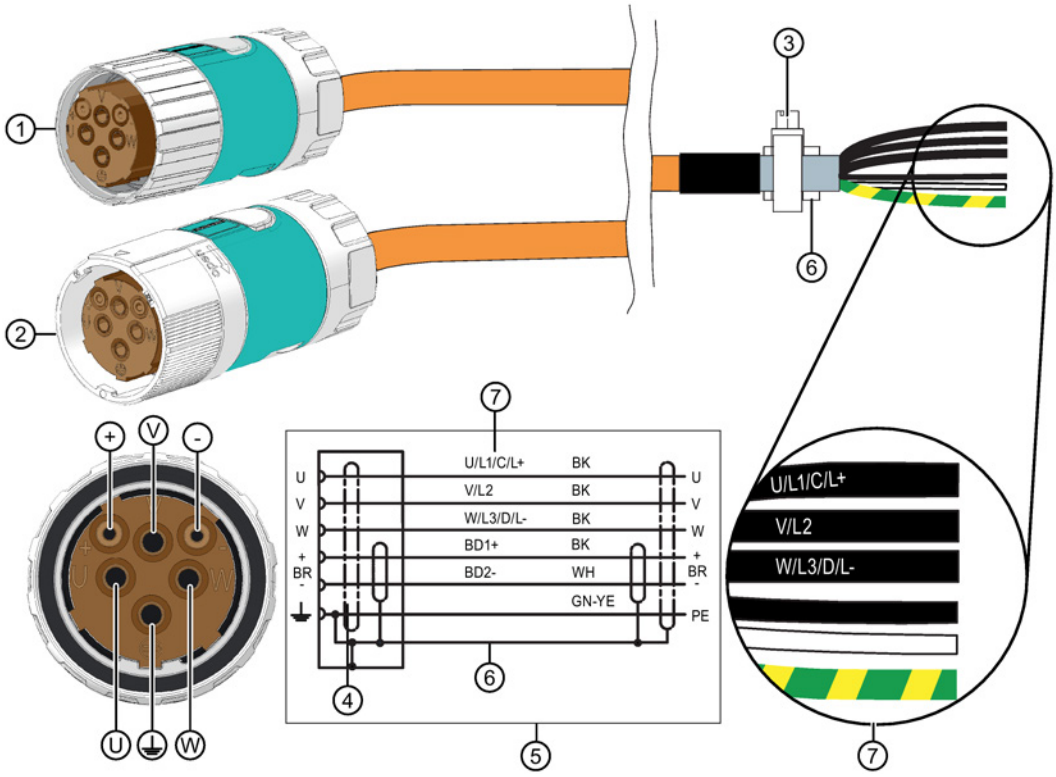
Connection scheme for the motor to the S120 Power Module and Motor Module Booksize and Compact

For connector size 1



1 Connector size 1
2 Connector SPEED CONNECT 1
3 Terminal for the cable shield
4 Pin assignment
5 Circuit diagram
6 Cable shield
7 Conductor designation:
U; V; W = power cables, 1.5 mm, each cable separately shielded
BD1+ and BD2- = brake cable without lettering, 1.5 mm, shared shield
PE = protective conductor

For connector size 1.5



1 Connector size 1.5
2 Connector SPEED CONNECT 1.5
3 Terminal for the cable shield
4 Pin assignment
5 Circuit diagram
6 Cable shield
7 Conductor designation:
U; V; W = power cables, each cable separately shielded
BD1+ and BD2- = brake cable without lettering, 1.5 mm, shared shield
PE = protective conductor

- Connect the shield at both ends at the motor and at the converter.
- Keep unshielded cable ends as short as possible.
- Establish the connection through a larger surface area so that high-frequency currents are suitably discharged. Establish a 360° connection at the converter and at the motor, for instance using EMC cable glands at the cable entries.

Commissioning

6

6.1 Safety instructions

⚠ WARNING

Danger to life as a result of hazardous voltages when connected to inadequately grounded line supplies

In the case of a fault, connecting a motor to an inadequately grounded line supply can result in death, severe injury and motor damage.

- Connect motors, as part of the drive system, to TN and TT line supplies with a grounded neutral point or to IT line supplies.
- Ensure that the SINAMICS devices and motors are compatible with the residual current device according to EN 61800-5-1 before you connect the devices and motors to the line supply using residual current devices (RCDs).
- For line supplies with grounded line conductor, e.g. TT line supplies, use an isolating transformer with grounded neutral point (on the secondary side) between the line supply and the drive system, so that the motor insulation is not overstressed.
- When connected to IT line supplies, a monitoring device must signal the first fault between an active part and ground. Remove this fault immediately.

⚠ WARNING

Danger to life caused by dangerous voltage while testing the insulation resistance

During the measurement and immediately afterwards, high voltages can be present at the terminals that can cause death or severe injury as result of an electric shock.

Contact to live parts causes electric shocks.

- Work on power installations must only be carried out by specialists.
- Before measuring the insulation resistance, read the manual for the insulation resistance meter you are going to use.
- Never touch the terminals when making measurements or immediately after the measurement.
- Check the connected supply feeder cables to ensure that the line supply voltage cannot be connected.

⚠ WARNING

Danger to life due to unintentional starting of the drive unit

Unintentional starting of the drive unit can cause death or severe injury.

- Make sure that the drive unit cannot be started accidentally.
- Post a warning notice to this effect at the point where the switch is located.

⚠ WARNING

Danger to life caused by a rotating shaft extensions and ejected parts

Rotating shaft extensions and the resulting ejected parts can cause death or injury.

- Secure rotating output elements using the appropriate safety guards.
- Secure loose parts, e.g. featherkeys to prevent the ejection.

⚠ WARNING

Danger to life caused by machine movement and loose objects

Machine movement and loose objects that can fall out or be ejected can cause death or severe injury.

- Ensure that the machine has been completely installed and all of the setting work completed.
- Ensure that nobody is at risk at switch on.
- Before switching on, check that there are no loose objects in or on the motor that can fall or be flung off.

⚠ CAUTION

Burns as a result of touching hot surfaces

In operation, the motor housing can reach high temperatures, which can cause burns if touched.

- Do not touch any hot surfaces.
- Allow the motor to cool down before starting any work.
- Use the appropriate personnel protection equipment, e.g. gloves.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electrical motor housing can reach temperatures that exceed 100° C. If temperature-sensitive parts, e.g. electric cables or electronic components, come into contact with hot surfaces, these parts could be damaged.

- Ensure that no temperature-sensitive parts are in contact with hot surfaces.

NOTICE

Motor damage when the maximum speed is exceeded

The maximum speed n_{max} is the highest permissible operating speed. The maximum speed is specified on the rating plate.

The motor can be damaged if operated at inadmissible speeds.

- Ensure that the maximum permissible speed is not exceeded. Realize this using a suitable control system or activate the speed monitoring function in the drive.

NOTICE
Motor damage caused by uneven running or abnormal noise The motor can be damaged by improper handling during transport, storage or installation. If a damaged motor is operated, this can damage the winding or bearings and could even destroy the system. • In case of uneven running or abnormal noise, switch off the motor. • Identify the cause.

6.2 Checklists for commissioning

Note

Required checks

The checklists below do not purport to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

Before commissioning the system, check that it is properly installed and connected.

Commission the drive system according to the operating instructions of the converter or inverter being used.

Checklists prior to commissioning 1FG1 motors

Thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Table 6- 1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Is the following, up-to-date SINAMICS documentation available when operating 1FG1 servo geared motors on the SINAMICS S120 drive system? • SINAMICS S120 Commissioning Manual • Getting Started S120 • S120 Function Manual • S120/150 List Manual	
If the 1FG1 servo geared motor is operated on the SINAMICS S120 drive system: Were the contents of the chapter "Checklists for commissioning SINAMICS S" in the SINAMICS S120 Commissioning Manual complied with?	
Is the motor type to be commissioned known? (e.g. 1FG1 _ _ _ – _ _ _ _ _ – _ _ _ _)	
Are the environmental conditions in the permissible range?	

Table 6- 2 Checklist (2) - checks regarding the mechanical system

Check	OK
Is the geared motor free of visible damage?	
Has the vent valve been mounted appropriately for the mounting position?	
Has the transportation lock of the vent valve been removed?	
Are all touch protection measures for moving and live parts installed and activated?	
Has the geared motor been mounted and aligned appropriately for the mounting position?	
Have all fastening screws, fastening elements, and electrical connections been tightened with the prescribed torques and properly attached?	
Do the operating conditions correspond to the data specified on the rating plate?	
Are the shaft sealing rings free of damage, mounting paste and other contamination?	

Table 6- 3 Checklist (3) - checks regarding the electrical system

Check	OK
Have the minimum insulation resistance values been maintained?	
Have the grounding and equipotential bonding connections been correctly established?	
Is the maximum permissible input speed n_{1max} maintained during operation on the converter?	

Table 6- 4 Checklist (4) - Monitoring equipment checks

Check	OK
Has it been ensured that speeds higher than the maximum permissible input speed of the gearbox n_{1max} cannot be reached?	
Have all supplementary motor monitoring devices been correctly connected and are they working properly?	

Table 6- 5 Checklist (6) - Checks regarding the optional brake

Check	OK
Does the brake open when the operating voltage is connected?	
Does the brake open and close correctly?	

Table 6- 6 Checklist (7) - Oil level checks

Check	OK
Does the oil level in the gearbox correspond to the prescribed level in this mounting position?	

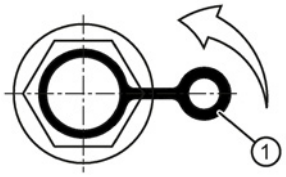
Table 6- 7 Checklist (8) - Roller bearing checks

Check	OK
For motors that were stored, were the storage conditions according to the "Storage" section and the bearing replacement intervals according to the "Bearing replacement intervals" section complied with?	

6.3 Preparing commissioning

Procedure

1. Remove the transportation lock of the pressure vent valve, if applicable.



① Transportation lock. Remove in the direction of the arrow.

Image 6-1 Pressure vent valve with securing clip

2. Check the oil level in the gearbox, and correct the oil level, if necessary. See Checking and changing lubricants (Page 145)

Note

For gearboxes with long-term preservation and gearboxes supplied completely filled with oil.

We recommend a complete oil change after a storage time longer than 24 months.

3. Mount an oil expansion unit. See Mount the oil expansion unit (Page 105)

You have prepared commissioning.

6.4 Configuration

Note

Assigning the parameters

Before you switch on the motor, check to ensure that the parameters of the frequency converter have been assigned correctly.

With SINAMICS Version 4.7 or higher, you can use appropriate commissioning tools.

6.5 Switching on and switching off

Note

EMERGENCY OFF

To avoid accidents, inform yourself about the EMERGENCY OFF function before you switch on the system.

The motor is switched on and off using the converter.

- Read about this topic in the converter operating instructions.

Before switching on

- Ensure that the converter is correctly parameterized.
- Use the appropriate commissioning tools, e.g. "Drive ES" or "STARTER".
- Check whether sufficient heat is dissipated from the motor.

Procedure

Switching on

1. Switch-on the motor at the converter.
2. Observe any uneven running and abnormal noise of the motor.
3. Check the function of the safety equipment.
4. Check as to whether the motor reaches the required parameters

Switching off

- Switch-off the motor at the converter.

You have commissioned the motor.

Operation 7

7.1 Safety instructions

⚠ WARNING

Danger to life caused by machine movement and loose objects

Machine movement and loose objects that can fall out or be ejected can cause death or severe injury.

- Ensure that the machine has been completely installed and all of the setting work completed.
- Ensure that nobody is at risk at switch on.
- Before switching on, check that there are no loose objects in or on the motor that can fall or be flung off.
- Before switching on, check that all safety guard covers are installed and all safety equipment functions correctly.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the frame of electric motors can reach temperatures that exceed 100°C. If temperature-sensitive parts, e.g. electric cables or electronic components, come into contact with hot surfaces, these parts could be damaged.

- Ensure that no temperature-sensitive parts are in contact with hot surfaces.

NOTICE

Motor damage when the maximum speed is exceeded

The maximum speed n_{max} is the highest permissible operating speed. The maximum speed is specified on the rating plate.

Impermissible speeds can cause damage to the gearbox on the servo geared motor.

- Ensure that the maximum permissible speed is not exceeded. Realize this using a suitable control system or activate the speed monitoring function in the drive.

NOTICE

Motor damage when the maximum torque is exceeded

The maximum torque M_{2dyn} is the maximum permissible torque. The maximum torque is specified on the rating plate.

Impermissible torques can cause damage to gearboxes.

- Using the controller, ensure the maximum torque is not exceeded.

NOTICE
Motor damage caused by uneven running or abnormal noise The servo geared motor can be damaged by improper handling during transport, storage or installation. If a damaged servo geared motor is operated, this can damage the winding or bearings and could even destroy the system. • In case of uneven running or abnormal noise, switch off the servo geared motor. • Identify the cause.

Check the gear unit during operation for:

- Excessive operating temperature
- Changes in gear noise
- Possible leakage at the housing and shaft seals.

7.2 Faults

Note

Faults and malfunctions occurring during the warranty period and requiring repair work on the geared motor must be remedied only by Technical Support.

If faults without a clearly identifiable cause occur after the warranty period has elapsed, consult Technical Support.

If you need the help from Technical Support, please have the following information ready:

- Rating plate data
- Nature and extent of the fault
- Suspected cause.

Note

Damage to the machine caused by faults

- Correct the cause of the fault as specified in the remedial measures section.
- Repair any damage to the machine/motor.

Note

When operating the motor with a converter, refer also to the operating instructions of the frequency converter if electrical faults occur.

- If changes occur with respect to normal operation or faults, determine the cause using the "Possible faults" table.
- If you have identified the cause, attempt to resolve the fault using the "Key – fault causes and remedial measures" table.
- In this regard, observe the relevant chapter in the documentation associated with the components of the complete drive system
- Even in test operation, never disable protective functions or devices

Table 7- 1 Possible faults on the geared motor

Fault	Cause of fault (see key table)						
Geared motor only starts with difficulty or not at all	A	B	F	S	GA	GR	
Droning motor noise on startup / during operation	A	F					
Unusual noise at the gearbox	A	GA	GB	GC	GD	GE	GH
Unusual noise at drive unit.	L	GC	GE				
Uneven running	J	K					
High motor temperature rise in no-load operation	D	I					
High motor temperature rise under load	A	C	J				
High motor temperature rise of individual winding sections	F						
Gearbox overheats.	I	GA	GR	GS	GC		
Vibrations	O	P	Q				
Oil escapes.	GA	GI	GK	GL	GM	GN	GO
Oil leak at the gearbox vent.	GA	GP					
Output shaft does not turn when the motor is running.	GT						
Excessive play at drive input and output.	GU	GV					

Table 7- 2 Key to causes of faults, and remedial measures

No.	Cause of fault	How to remedy
A	Overload	Reduce load
B	Interrupted phase in the supply cable/motor winding	Check the converter and supply cables/measure the winding resistances and insulation resistances, repair after consultation with manufacturer
C	Interruption of a phase in the supply cable after switching on	Check the converter and supply cables/check the winding resistances
D	Converter output voltage too high, frequency too low	Check the converter settings, perform automatic motor identification.
F	Winding short circuit or phase short circuit in stator winding	Measure the winding resistances and insulation resistances, and repair after consultation with manufacturer
I	Heat dissipation impeded by deposits	Clean the surface of the drives. Ensure that the cooling air can flow in and out unimpeded.
J	Insufficient shielding for motor and/or encoder cable	Check the shielding and grounding
K	Drive controller gain too high	Adjust the controller.
L	Rotating parts are grinding	Determine cause and adjust parts
	Foreign bodies in the motor	Send to manufacturer for repair
	Bearing damage	Send to manufacturer for repair
N	Rotor out of true, shaft bent	Consult the manufacturer
O	Poor alignment	Align machine set, check coupling.
P	Coupled machine not balanced	Rebalance coupled machine.
Q	Mechanical shocks from coupled machine	Inspect coupled machine.
R	Uneven gearbox operation	Repair the gearbox.

No.	Cause of fault	How to remedy
S	Motor brake is not released	Check circuit/connection of brake
GA	Incorrect oil level for the mounting position used and / or incorrect venting position.	Check the mounting position (Page 27) and the oil level (Page 145).
GB	Foreign bodies in oil (irregular noise).	Checking the oil quality (Page 148), Changing oil (Page 149)
GC	Excessive bearing play and/or bearing defective.	Check the bearing and replace if necessary.
GD	Defective gearing.	Check the gearing and replace if necessary.
GE	Fastening bolts loose.	Tighten the screws, Thread sizes and tightening torques for fastening bolts (Page 144)
GH	Damage due to blockage during commissioning.	Call Technical Support.
GI	Gearbox leaks.	Checking the gearbox for leaks (Page 162). Seal the gearbox
GK	Overpressure due to lack of venting.	Mount the venting as appropriate for the mounting position (Page 27).
GL	Overpressure due to soiled venting.	Replacing the vent valve (Page 164)
GM	Shaft sealing rings defective.	Replace the shaft sealing rings.
GN	Cover / flange bolts loose.	Tighten the screws (Page 144). Continue to monitor the gearbox.
GO	Surface sealing defective (e.g. on cover, flange).	Reseal.
GP	Frequent cold starts during which the oil foams up.	Call Technical Support.
GR	Incorrect oil used (e.g. incorrect viscosity).	Check the oil quality, change the oil (Page 162) and flush the gearbox (Page 151)
GS	Oil is too old.	Check the date of last oil change. If required, change the oil (Page 149).
GT	Force flow interrupted by breakage in gearbox.	Call Technical Support.
GU	Positive connection disrupted by overload.	Call Technical Support.
GV	Flexible elements worn (e.g. on couplings).	Replace flexible elements.

If the fault still cannot be resolved after taking the measures stated above, please contact the manufacturer or the Siemens Service Center.

7.3 Measures for longer non-operational periods

NOTICE
Damage due to improper storage The motor can be damaged if it is not stored properly. • If the motor is not operational for longer periods of time, preserve it by means of anti-corrosion protection and ensure that it remains dry (e.g. appropriate drying agents). • When recommissioning the motor after it has been out of service for a longer period of time, carry out the measures recommended in Chapter "Commissioning".

- Store the geared motor according to the instructions in chapter Storing the servo geared motor (Page 75).
- Refer to the section Switching on and switching off (Page 131) before recommissioning the motor

Service and maintenance

8

8.1 Safety instructions

If you have any questions, please contact the manufacturer, informing them of the machine type and serial number.

⚠ WARNING

Danger to life when live parts are touched

Death or serious injury can result when live parts are touched.

- Only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.

Generally, six steps apply when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the power supply.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that it really de-energized, from phase to phase and phase to protective conductor.
   - Check that every auxiliary circuit is de-energized.
   - Ensure that the motors cannot move.
3. Secure SIMOTICS S motors against unintentional movements that generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources, for example by closing switches, grounding or short-circuiting, or closing valves.
6. Take measures to prevent reconnection of the energy sources.
7. Make sure that the machine is completely locked ... and that you have the right machine.

After you have completed the work, restore operational readiness by performing the above steps in the reverse order.

⚠ WARNING

Danger to life due to slipping on leaked oil

Leaked oil can result in slipping or falling and cause death or severe injury.

- Prevent oil from leaking
- Absorb leaked oil immediately with a binding agent for oil or similar.
- Rough up the hazardous location.
- Mark the hazardous location.

⚠ WARNING

Danger to life due to unintentional starting of the drive unit

Unintentional starting of the drive unit can cause death or severe injury.

- Make sure that the drive unit cannot be started accidentally.
- Post a warning notice to this effect at the point where the switch is located.

⚠ CAUTION

Burning hazard caused by hot surfaces

Some parts of the frame of electrical machines can reach temperatures in excess of 100°C. Touching components when the machine is in operation can cause burns.

- Do not touch frame parts while the machine is in operation or immediately after machine operation.
- Allow frame parts to cool off before starting any work.

⚠ CAUTION

Danger of scalding from the hot oil exiting the unit

Exiting hot oil can cause burns.

- Before starting any work, wait until the oil has cooled down to below 30° C.

⚠ CAUTION

Chemical burns and irritations caused by chemical cleaning agents

Chemical cleaning agents can be caustic or emit dangerous fumes. If these come into contact with skin or if you inhale the fumes, this can cause injuries (e.g. chemical burns on the skin or respiratory passages, or skin irritation).

- During cleaning, make sure that appropriate methods of extracting fumes are in place and that you wear the appropriate protective gear (e.g. gloves, goggles, face masks).
- If using chemical cleaning agents, observe the instructions and any warnings provided in the relevant safety data sheet. Chemical cleaning agents must be suitable for use with the machine's components, particularly where plastic components are concerned.

⚠ CAUTION

Injuries caused by stirred-up foreign bodies and dust when working with compressed air

When you clean using compressed air, this can stir up dust, metal chips and cleaning agents, and so cause injuries.

- When cleaning using compressed air, make sure you use suitable extraction equipment and wear protective equipment (safety goggles, protective suit, etc.).

⚠ WARNING

Danger to life when lifting and transporting

Incorrect lifting and transport operations, and devices and equipment that are unsuitable or damaged can result in death, severe injury and/or damage to property.

- Lifting devices, ground conveyors, and load suspension equipment must comply with requirements.
- The maximum capacity of the lifting equipment and the load suspension device must correspond to the weight of the motor (see the rating plate).
- Do not attach any additional loads to the lifting equipment.
- To hoist the motor, use suitable cable-guidance or spreading equipment, particularly if the motor is equipped with built-on assemblies.
- The motor must not be lifted or transported by means of the power connector or signal connector.
- Do not stand in the slewing range of hoisting gear or under suspended loads.

⚠ WARNING

Danger to life through incorrect or unused lifting points

Through incorrect or unused lifting points, the motor can fall and cause death, severe injury and/or material damage

- Lift and transport large motors using the eyebolts screwed on to the end shields.
- Completely screw in the eyebolts and tighten by hand (approx. 8 Nm).
- Do not use bent or damaged eyebolts.
- Use only eyebolts with laminated fiber washers.
- Loads applied transversely to the plane of the eyebolts are not permitted.

⚠ WARNING

Danger of injury due to suspended loads

While being transported, the motor can cause injury by moving.

- Use only perfectly functioning hoisting and load suspension equipment dimensioned to carry the motor load.
- Do not stand under suspended loads or in their slewing range.
- When placing down the motor, ensure that it cannot roll.

8.2 Inspection and maintenance

8.2.1 Maintenance and inspection intervals

General

Carry out maintenance work, inspections and revisions at regular intervals in order to be able to identify faults at an early stage and remove them.

Note

Inspection if there are faults or unusual conditions

Unusual conditions or faults that represent overstressing of the motor, e.g. overload or short-circuit, can result in consequential damage to the machine.

Immediately perform an inspection when faults or exceptional conditions occur.

Maintenance measures, inspection/maintenance times intervals

The maintenance intervals depend on the operating conditions.

- Adapt the maintenance intervals to match the local conditions, such as pollution/dirt, switching frequency, load, etc.
- Perform the following maintenance measures as specified in the table.

Maintenance and repair of the geared motor can be performed by Siemens Service Centers throughout the world.

Consult your Siemens representative (http://www.siemens.com/industry/contact) if you require this service

NOTICE
Improper maintenance Service and maintenance must only be performed by properly authorized qualified personnel. Use only original SIEMENS parts.

Table 8- 1 Maintenance measures after operating times or intervals

Operating tines and intervals	Measure	Description of the work
Commissioning		
3 hours	Check that fastening bolts on gearboxes and add-on elements are securely tightened. Check that covers and plugs are securely fastened.	Checking tightness of fastening bolts (Page 163)
1 day	Checking the oil level.	Checking the oil level (Page 145)
	Check the housing temperature.	Cooling of the servo geared motor (Page 62)
	Monitor and check the geared motor for unusual noise, vibrations, and changes.	Consult your Siemens representative (http://www.siemens.com/industry/contact) if you detect any abnormalities
	Check the gearbox for leaks.	Checking the gearbox for leaks (Page 162)
Operation		
Daily; if possible, more frequently during operation.	Monitor and check the geared motor for unusual noise, vibrations, and changes.	Consult your Siemens representative (http://www.siemens.com/industry/contact) if you detect any abnormalities
Monthly	Check the housing temperature.	Cooling of the servo geared motor (Page 62)
	Check the gearbox for leaks.	Checking the gearbox for leaks (Page 162)
Every 3 000 operating hours, or at least every 6 months.	Checking the oil level.	Checking the oil level (Page 145)
	Check the oil quality.	Checking the oil quality (Page 148)
	Clean the gearbox.	Cleaning the gearbox (Page 163)
	Check the rubber buffer of the torque arms.	Torque arms with shaft-mounted gearboxes (Page 102)
	Check the corrosion protection and repair, if necessary	
Once a year.	Replace the venting valve, if present.	Replacing the vent valve (Page 164)
Every 10 000 operating hours, or at the latest after 2 years	Changing the oil and the roller bearing grease in the gearbox	Changing oil (Page 149) Change the roller bearing grease (Page 154)
Every 10 000 operating hours, or at the latest after 2 years	Check that fastening bolts on gearboxes and add-on elements are securely tightened. Check that covers and plugs are securely fastened.	Checking tightness of fastening bolts (Page 163)
	Changing the oil and the roller bearing grease in the gearbox [1)]	Changing oil (Page 149) Change the roller bearing grease (Page 154)

Operating tines and intervals	Measure	Description of the work
after 25 000 operating hours	Replacement of the motor bearings, the encoder and the shaft sealing ring on the motor side	Consult your Siemens representative (http://www.siemens.com/industry/contact) if you require this service
when required	Change the gearbox bearing	Bearing replacement interval (Page 145)
	Replace the shaft sealing ring on the output side	Check the gearbox for leaks (Page 162)

[1] When using synthetic oils, the intervals can be doubled. The data specified is valid for an oil temperature of +80° C. For the oil change intervals for other temperatures, see the figure titled "Guide values for oil change intervals" in chapter "Service life of the lubricants (Page 154)" .

See also

Siemens Service Center (https://support.industry.siemens.com/cs/?lc=de-WW)

8.2.2 Thread sizes and tightening torques for fastening bolts

The general tolerance for the tightening torque is 10 %. The tightening torque is based on a friction coefficient of μ = 0.14.

Table 8- 2 Tightening torques for fastening bolts

Thread size	Tightening torque at strength class (Nm)		
	8.8	10.9	12.9
M4	3	4	5
M5	6	9	10
M6	10	15	18
M8	25	35	41
M10	50	70	85
M12	90	120	145
M16	210	295	355
M20	450	580	690
M24	750	1000	1200

8.2.3 Bearing replacement interval

The bearings are subject to wear and must be replaced after a defined number of operating hours.

Note

Bearing replacement interval dependency on the operating conditions

Bearing change intervals can be extended if the motor is operated under favorable conditions, e.g. low or medium speeds, low radial forces (transverse forces), vibration load.

Unfavorable conditions, e.g. high vibration/shock loads, frequent reversing operation, reduce the bearing replacement intervals t_{LW} by up to 50%.

In the case of operating conditions listed by the operator, the bearing service life for the bearings in the gearbox can be calculated with the help of the SIZER configuring tool.

If there are no specifications, replace the bearings in the gearbox when you detect changes in the vibration and noise characteristics.

With medium loads, replace the motor bearings, the shaft sealing ring on the motor side, and the encoder after 25 000 operating hours.

8.2.4 Checking and changing lubricants

8.2.4.1 Checking the oil level

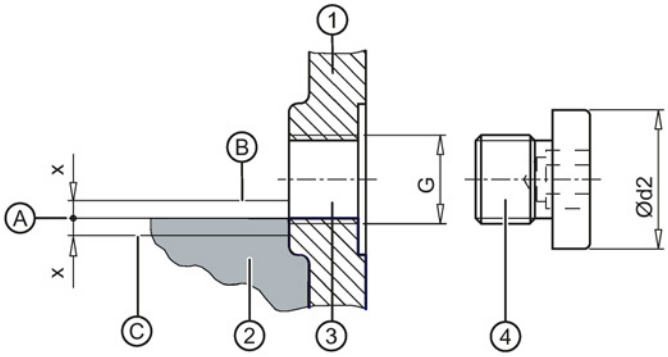
Note

Check the oil level at operating temperature

If the temperature rises, the volume of the gearbox oil increases.

In the case of greater temperature differences and filling quantities, the volume can vary by several liters.

- Check the oil level approximately 30 minutes after switching off the drive unit and while it is still slightly warm.



1 Gearbox panel
2 Gearbox oil
3 Oil level bore hole
4 Sealing plug
A Specified oil level
B Maximum oil level
C Minimum oil level

Image 8-1 Oil level in the gearbox

Minimum and maximum permissible oil level

Minimum permissible oil level: C = A - x

Maximum permissible oil level: B = A + X

Oil level hole	Ø d2	Maximum permissible deviation x	Tightening torque
	[mm]	[mm]	[Nm]
G 1/8"	14	2.5	10
G 1/4"	18	3	10
G 3/8"	22	4	25
G 3/4"	32	7	50

Procedure

1. Switch off the power supply to the drive unit.
2. Unscrew the oil level plug.

Image 8-2 Identifying marking for oil level plug

→ Oil escapes if the maximum fill level is above the plug hole.

Note

Use a suitable vessel to collect any escaping oil.

3. Check the oil level in accordance with fill level x.
4. Top up the oil level if necessary and check it again.
5. Check the state of the sealing ring on the sealing element. Replace the sealing element if the sealing ring is damaged.
6. After checking, seal the gearbox immediately using the sealing element.

You have now checked the oil level in the gearbox housing.

8.2.4.2 Checking the oil level using the oil sight glass (optional)

If there is an oil sight glass, the oil level ① must be in the center of the sight glass when the oil is cool.

The oil level ① of hot oil is above the center of the sight glass. The oil level ① of cold oil is below the center of the sight glass.

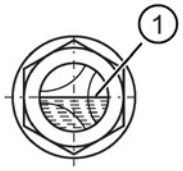


Image 8-3 Oil level in the oil sight glass

Top up the oil level ① if necessary, and check it again.

8.2.4.3 Checking the oil quality

You detect changes in the oil by its appearance.

Fresh oil is clear to the eye, and has a typical smell and a specific product color.

Clouding or a flocculent appearance indicates water and / or contamination.
A dark or black color indicates residue, serious thermal decomposition or contamination.

Procedure

1.
2.

1. Allow the geared motor to run for a short time. Wear and contaminant particles are visible in the oil shortly after shutting down.
2. Switch off the power supply to the drive unit.
3. Unscrew the vent plug or oil level plug.

Identifying marking of vent plug	Identifying marking for oil level plug

4. Remove some oil, using a suction pump and a flexible hose, for example.
5. Check the state of the sealing ring on the sealing element. If required, replace the sealing ring.
6. Seal the gearbox with the sealing element.
7. Check the oil for the changes described above. Change the oil immediately if you determine any changes, see chapter "Changing the oil (Page 149)".

You have now checked the oil quality.

8.2.4.4 Changing the oil

Safety instructions

NOTICE

Gearbox damage due to mixing of different oils

Mixing different oils can damage the gearbox by forming deposits or foam,

changing the viscosity, or reducing corrosion protection.

- Use gearbox oils of the same type and from the same manufacturer. If you use other oils, have the manufacturer confirm that the new oil is compatible with the remaining volume of used oil.
- Change the oil completely.
- If you use other oil types, flush the gearbox with the new oil.
- Avoid contaminating the new oil.

NOTICE

Damage to the gearbox caused by incorrect oil quantities

The incorrect oil quantity can damage the gearbox depending on the mounting position.

- Install the geared motors only in the prescribed mounting position.
- Regulate the oil level in accordance with the oil level plug. The oil level must not be below the specified fill level.
- Prevent any contamination from getting into open oil bore holes.
- Carefully close the oil bore holes after regulating the oil level.

Note

When changing the oil, use the same oil type as that given on the information plate on the gearbox if possible.

Draining the oil

Note

Change the oil when warm because oil that is too cold is difficult to remove fully.

Operate the gearbox for 15 to 30 minutes to warm up, if necessary.

Procedure

1. Switch off the power supply to the drive unit.
2. Unscrew the vent plug.

Image 8-4 Identifying marking of vent plug

3. Place a suitable and sufficiently large receptacle underneath the oil drain plug.

Image 8-5 Identifying marking for oil drain plug

4. Remove the oil drain plug. Drain all the oil into the receptacle.
5. Check the state of the sealing ring on the sealing element. If the sealing ring is damaged, replace the sealing element with a new one.
6. After draining the oil, seal the gearbox immediately using the sealing element.

You have now drained the oil from the gearbox.

Flushing the gearbox when changing between incompatible oils

Note

Polyglycol oil has a higher density than mineral oil. Polyglycol oil sinks to the bottom in the gearbox and mineral oil floats on the surface.

This makes the required complete draining of mineral oil from the gearbox extremely difficult.

Note

After the second flush, we recommend that an appropriate analysis institute checks the quality of the flushed fluid.

Procedure

1. After the oil has been drained, wipe the gearbox clean of any remaining mineral oil using a lint-free cloth.
2. Unscrew the vent plug.

Image 8-6 Identifying marking of vent plug

3. Fill the gearbox completely with a flushing oil, using a filter (filter mesh max. 25 µm). For the flushing oil, use the new oil or one that is compatible with the new oil and is less expensive.
4. Operate the gearbox for 15 to 30 minutes under a low load.
5. Place a suitable and sufficiently large receptacle underneath the oil drain plug.
6. Remove the oil drain plug.
   Drain all the oil into the receptacle.

Image 8-7 Identifying marking for oil drain plug

7. After flushing, immediately seal the gearbox using the sealing element.
8. Repeat this step for the second flushing.

You have now flushed the gearbox twice and can pour in the new oil.

Filling in oil

Note

You can find the required oil quantity in chapter "Oil quantities (Page 157)".

Procedure

1.
2.

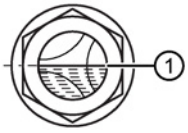
1. Unscrew the vent plug.

Image 8-8 Identifying marking of vent plug

2. Refill the gearbox with the required quantity of fresh oil. Use a filler filter with mesh of max. 25 µm.

Image 8-9 Identifying marking oil filling inlet

3. Check the oil level.

Identifying marking for oil level plug	 Oil level in the oil sight glass

4. Top up the oil level if necessary and check it again.
5. Check the state of the sealing ring on the sealing element. If the sealing ring is damaged, replace the sealing element with a new one.
6. After filling with oil, seal the gearbox immediately using the sealing element.
7. Screw in the vent plug.

You have now filled up the gearbox with oil.

8.2.4.5 Recommended oil types

Note

These recommendations are not a guarantee of the lubricant quality provided by your supplier. All lubricant manufacturers are responsible for the quality of their own products.

The oil viscosity is a decisive factor in choosing the oil (ISO VG class). The viscosity is specified on the rating plate of the gearbox. The viscosity class indicated applies for the contractually agreed operating conditions.

In the case of different operating conditions, please contact Technical Support.

At the time of going to print, the following types of oil are being used when the gearbox is filled for the first time:

CLP ISO VG220: Exxon Mobil Mobilgear 600 SP 220

CLP ISO E VG220: Fuchs Renolin PG220

CLP ISO H1 VG460: Castrol Tribol 1300/460

CLP ISO H1 VG460: Castrol Tribol Foodproof 1800/460

If, following agreement, the gearbox is filled at the factory with special lubricant for the special applications referred to above, the lubricant is shown on the rating plate.

The quality of the oil used must comply with the requirements laid down in the BA 7300 Operating Instructions; otherwise, the Siemens warranty is null and void. We recommend the use of an approved gearbox lubricant specified in the T 7300 (http://support.automation.siemens.com/WW/view/de/44231658) Operating Instructions. These oils have been tested appropriately and satisfy the requirements.

The oils listed in the operating instructions are subject to continuous testing. It is possible that the oils recommended in the operating instructions are at a later point in time removed or replaced by oils that have been further developed.

We recommend that you regularly check as to whether the selected lubricating oil is still recommended by Siemens. Otherwise change the product.

8.2.4.6 Change the roller bearing grease

The roller bearings are lubricated in the factory with the greases listed in the table.

Table 8- 3 Roller-bearing and shaft-sealing-ring grease

Fields of application	Ambient temperature	Manufacturer	Type
Standard	-40 °C to +80 °C	Klüber	Petamo GHY 133 N
Foodstuff-compatible for the food industry	-30 °C to +40 °C	Castrol	Obeen UF F2 NSF H1
Biologically degradable, for agriculture, forestry and water industries	-35 °C to +40 °C	BP	Biogrease EP 2

- Renew the grease on grease-lubricated bearings with each oil change.
- Clean the bearing before applying fresh lubricant.

In the case of bearings on the output shaft or intermediate shafts, the grease quantity must fill 2/3, and in the case of bearings on the input side, 1/3 of the space between the rolling elements.

Note

Consult your Siemens representative (http://www.siemens.com/industry/contact) if you have any questions

8.2.4.7 Service life of the lubricants

Note

The intervals between changes become shorter in the case of deviations from the permissible operating conditions, e.g. high ambient temperatures, high relative humidity, and aggressive ambient media.

- Contact Technical Support to determine the individual interval for changing the lubricant.

For a +80 °C oil sump temperature, the following service life can be expected when observing the properties specified by Siemens AG:

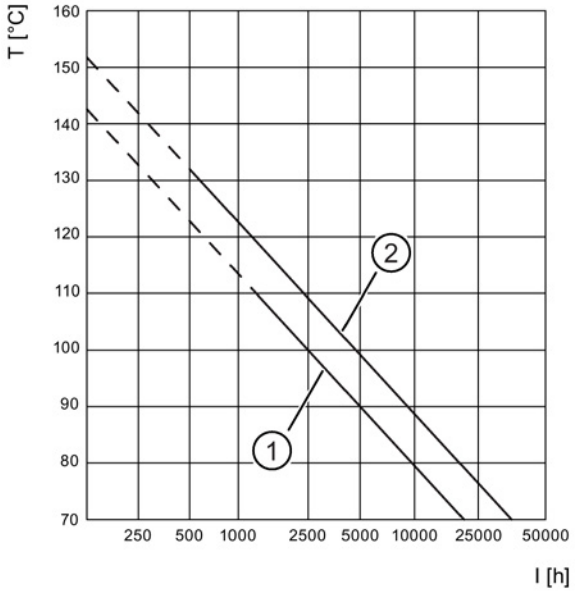
Table 8- 4 Service life of the oils

Type of oil	Service life
Mineral oil	10 000 operating hours or 2 years [1]
Biodegradable oil	
Physiologically safe oil according to USDA-H1/-H2	
Synthetic oil	20 000 operating hours or 4 years [1]

[1] Depending on what occurs first.

Note

Oil sump temperatures above +80 °C can reduce service life. A temperature increase by 10 K approximately halves the service life, see the figure titled "Guide values for oil change intervals".



① Mineral oil
② Synthetic oil
T Oil-bath steady-state temperature [°C]
I Oil change interval in operating hours [h]

Image 8-10 Guide values for oil change intervals

Grease service life of roller bearing greases

Roller bearings and the clearance in front are filled with sufficient grease.

Under approved operating conditions and ambient temperatures, no regreasing is required.

We recommend that the grease in the bearings is also renewed when the oil or shaft sealing rings are replaced.

8.2.4.8 Recommended lubricants

⚠ WARNING

Used lubricants only have conditional approval

The used lubricants are not or only conditionally approved for use in the foodstuff or pharmaceutical industry.

Use only lubricants with USDA (United States Department of Agriculture) H1 / H2 approval for deployment in the foodstuff or pharmaceutical industry.

The released and recommended lubricants are listed in the T 7300 Operating Instructions.

NOTICE

Incorrect operating temperatures impair the lubricity of the gearbox oil

Operating temperatures outside the permitted range impair the lubricating property of the gearbox oil.

The temperature ranges are listed in the T 7300 Operating Instructions, see chapter "Approved lubricants (https://support.industry.siemens.com/cs/#document/44231658?lc=de-WW)

If you are working outside the specified temperature ranges, contact Technical Support for advice on which oil to use.

If the housing temperature exceeds a value of +80 °C, contact Technical Support.

Note

As standard, the lubricants and shaft seals are harmonized and coordinated with one another corresponding to the prevailing operating conditions.

Contact Technical Support for:

- Change of the operating conditions
- Change in oil grade
- Deployment of new shaft seals.

Note

The lubricants used are not at all or only conditionally biodegradable. If biologically degradable lubricants are required, use only gearbox lubricants with the appropriate classification listed in the T 7300 Operating Instructions.

Note

These recommendations are not a guarantee of the lubricant quality provided by your supplier. All lubricant manufacturers are responsible for the quality of their own products.

The oil viscosity is decisive for the oil selection (ISO VG class). The viscosity is specified on the rating plate of the gearbox. The viscosity class indicated applies for the contractually agreed operating conditions.

In the case of different operating conditions, contact Technical Support.

If, following agreement, the gearbox is filled at the factory with special lubricant for the special applications referred to above, the lubricant is shown on the rating plate.

Use an approved gearbox lubricant from chapter "Recommended oil types (Page 153)". These oils have been tested and satisfy the requirements.

Note

Before use, check that the selected lubricating oil is still recommended by Siemens.

Consult your Siemens representative, if applicable.

8.2.4.9 Oil quantities

Safety guidelines

NOTICE
Damage to the gearbox caused by incorrect oil quantities
Incorrect oil quantities can cause gearbox damage. • Check the oil level before commissioning.

Note

The oil quantities listed in the tables are guide values for changing the oil.

The precise values depend on the number of stages and transmission ratio of the gearbox.

Oil quantity in the helical gearbox

Table 8- 5 Oil quantities [l] for D/Z, DB/ZB, DF/ZF and DZ/ZZ sizes 29 - 89

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
Z.29	0.2	0.7	0.45	0.6	0.55	0.3
Z.39	0.3	0.95	0.85	0.95	0.9	0.25
Z.49	0.55	1.9	1.9	1.9	1.8	0.65
Z.59	0.65	2	1.9	1.9	1.9	0.6
Z.69	0.65	2.1	2.6	2.6	2.3	0.85
Z.79	1.1	3.8	3.9	3.9	3.7	1.4
Z.89	2.2	6.9	6.7	6.7	6.6	2.4
D.29	0.15	0.65	0.45	0.5	0.55	0.4
D.39	0.25	0.9	0.8	0.85	0.8	0.7
D.49	0.55	1.8	1.8	1.7	1.7	1.2
D.59	0.45	1.9	1.9	1.8	1.8	1.2
D.69	0.6	2	2.4	2.3	2.2	1.5
D.79	1	3.5	3.7	3.6	3.4	2.3
D.89	2	6.5	6.2	6	6	4.2
D.109	2.9	11.3	11.3	10	9.8	7.3
D.129	5.6	17.9	18.5	17.7	16.9	12.1

Oil quantity in the parallel shaft gearbox

Table 8- 6 Oil quantities [l] for FZ and FD sizes 29 - 129

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
FZ.29	0.6	0.9	0.4	0.7	0.5	0.45
FZ.39	0.95	1.3	0.8	1.4	0.9	0.85
FZ.49	1.6	2.5	1.6	2.5	1.6	1.6
FZ.69	2.2	2.8	1.6	2.9	1.9	1.9
FZ.79	2.8	4.1	2.9	4.2	2.7	2.9
FZ.89	4.9	7.7	5.9	8.4	5.2	5.5
FZ.109	9.1	13.7	9.4	13.1	9	9.3
FZ.129	15.6	21.5	16.7	25	15.6	16.3
FD.29	0.6	0.8	0.35	0.6	0.45	0.45
FD.39	0.95	1.1	0.7	1.2	0.8	0.8
FD.49	2.1	2.3	1.5	2.3	1.5	1.5
FD.69	2.2	2.7	1.6	2.7	1.8	1.8
FD.79	3	3.8	2.7	3.9	2.6	2.7
FD.89	5.6	7.6	5.9	7.8	5.1	5.2
FD.109	9.5	13	9.2	11.8	8.5	8.5
FD.129	16.1	20	16.3	23.5	14.9	15

Table 8- 7 Oil quantities [l] for FZ.F and FD.F sizes 29 - 129

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
FZ.F29	0.6	0.9	0.4	0.7	0.5	0.45
FZ.F39	1	1.4	0.85	1.6	0.95	0.9
FZ.F49	1.8	2.4	1.5	2.6	1.6	1.6
FZ.F69	2.4	2.9	1.6	3.1	2	2
FZ.F79	2.9	4.2	2.9	4.3	2.9	2.8
FZ.F89	5.1	7.7	5.8	8.6	5.3	5.4
FZ.F109	9.2	13.7	9.4	13.3	9.1	9.4
FZ.F129	16	21.5	16.7	25.5	15.8	16.5
FD.F29	0.6	0.8	0.35	0.6	0.45	0.45
FD.F39	1	1.2	0.75	1.3	0.8	0.85
FD.F49	2.2	2.3	1.5	2.4	1.6	1.5
FD.F69	2.4	2.8	1.6	2.9	1.9	1.9
FD.F79	3.1	3.9	2.7	4	2.7	2.6
FD.F89	5.8	7.6	5.8	8	5.2	5.2
FD.F109	9.7	13	9.2	12	8.6	8.6
FD.F129	16.4	20	16.3	23.5	15.1	15.2

Oil quantity in the bevel gearbox

Table 8- 8 Oil quantities [l] for B, sizes 29 - 49

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
B.29	0.25	0.55	0.7	0.85	0.55	0.5
B.39	0.5	0.95	1.3	1.6	0.95	0.9
B.49	1	1.7	2.4	3.2	1.8	1.5

Table 8- 9 Oil quantities [l] for K. and KA sizes 39 - 149

Type	Mounting position					
	M1	M2	M3	M4	M5-A M6-B	M6-A M5-B
K.39	0.35	0.85	1.1	1.2	0.85	0.9
K.49	0.55	1.4	1.8	1.9	1.5	1.6
K.69	0.75	2	2.5	2.7	2.2	2.2
K.79	1	2.2	2.9	3.4	2.7	2.5
K.89	1.9	4.5	6	6.8	5	5.3
K.109	3	7.8	8.3	10.5	7.1	7.5
K.129	6.2	13.4	16.6	19.5	13.2	13.6
K.149	9.3	21	28	33	21.5	22.5

Table 8- 10 Oil quantities [l] for KAF, KAZ and KAD sizes 39 - 149

Type	Mounting position					
	M1	M2	M3	M4	M5-A M6-B	M6-A M5-B
KA.39	0.4	0.9	1.2	1.3	0.95	0.95
KA.49	0.65	1.5	1.9	2.2	1.6	1.6
KA.69	0.85	2.1	2.8	3.2	2.4	2.5
KA.79	1.1	2.4	3.1	3.7	2.5	2.7
KA.89	2.2	4.7	6.2	7.3	5.3	5.6
KA.109	3.7	8	9.6	11.7	7.6	8.2
KA.129	6.5	13.5	17.5	20.5	13.8	14.2
KA.149	9.6	21.5	29	34.5	22.5	23.5

Table 8- 11 Oil quantities [l] for KF sizes 39 - 149

Type	Mounting position					
	M1	M2	M3	M4	M5-A M6-B	M6-A M5-B
KF39	0.35	0.9	1.2	1.3	0.95	1
KF49	0.6	1.4	2	2.2	1.6	1.7
KF69	0.85	2	2.8	3.1	2.4	2.4
KF79	1.2	2.3	3.1	3.8	3	2.5
KF89	2.1	4.6	6.5	7.6	5.6	5.5
KF109	3.6	7.9	9.8	11.7	8.1	7.8
KF129	6.7	13.9	18.1	21.5	14.4	14.8
KF149	9.7	22	30.5	36	23	24

Oil quantity in the helical worm gearbox

Table 8- 12 Oil quantities [l] for C. and CA. Sizes 29 - 89

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
C.29	0.15	0.5	0.6	0.55	0.35	0.4
C.39	0.3	1.1	0.95	1	0.55	0.6
C.49	0.55	1.8	1.7	1.8	1	1.1
C.69	0.75	2.6	2.6	2.9	1.6	1.7
C.89	1.2	4.2	4.8	5	2.8	2.9

Table 8- 13 Oil quantities [l] for CAD, CAF and CAZ, sizes 29 - 89

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
CA.29	0.15	0.5	0.55	0.5	0.35	0.35
CA.39	0.3	1.1	0.95	1	0.6	0.6
CA.49	0.6	1.9	1.8	1.9	1.1	1.1
CA.69	0.8	2.6	2.6	3	1.6	1.6
CA.89	1.4	4.4	5	5.4	3	3

Table 8- 14 Oil quantities [l] for CF, sizes 29 - 89

Type	Mounting position					
	M1	M2	M3	M4	M5	M6
CF29	0.15	0.5	0.55	0.5	0.35	0.35
CF39	0.3	1.2	1	1.1	0.65	0.65
CF49	0.6	2	1.9	2	1.2	1.2
CF69	0.8	2.6	2.6	3	1.6	1.6
CF89	1.4	4.4	5	5.4	3	3

8.2.5 Checking the gearbox for leaks

Note

From the inherent principle of operation, oil mist can escape from the vent valve or a labyrinth seal.

Small quantities of oil or grease can escape at the shaft sealing ring during the run-in period of 24 hours operating time.

If significant leaks occur, or if a leak persists after the run-in period, replace the shaft sealing ring.
This prevents follow-on damage.

Shaft sealing rings are subject to natural wear. The service life depends on the rated conditions.

We recommend that shaft sealing rings are included in periodic maintenance and servicing work on the system.

Table 8- 15 Description and measures

Status	Description	Measures	Notes
Film of moisture on the shaft sealing ring	Film of moisture as a result of the inherent principle of operation (apparent leakage)	Remove using a clean cloth and continue to observe.	No fault present. The sealing ring usually dries off during further operation.
Leakage at the shaft sealing ring	Identifiable small trickle, formation of drops, also after the running-in phase	Have the shaft sealing ring replaced.	During the run-in period, the shaft sealing ring beds into the shaft. A visible track can be seen on the shaft. Optimum preconditions for a perfect seal are obtained after the run-in period.

8.2.6 Cleaning the gearbox

NOTICE
Damage to the gearbox due to increased housing temperatures resulting from dust deposits Dust deposits prevent heat dissipation, increase the temperature of the gearbox housing, and can cause damage to the gearbox. • Remove dirt and dust from the geared motor.

NOTICE
Damage to the gearbox caused by the ingress of water resulting from cleaning with high-pressure cleaning equipment If you clean the geared motor with high-pressure cleaning equipment, seals may be damaged, water can penetrate into the geared motor, and the geared motor can be damaged. • Do not use high-pressure cleaning equipment to clean the geared motor. • When cleaning, do not use any tools with sharp edges.

Switch off the power supply to the drive unit prior to cleaning.

8.2.7 Checking tightness of fastening bolts

Note

Replace unusable headless screws with headless screws of the same design and property class.

- Switch off the power supply to the drive unit.
- Check all fixing screws for tightness using a torque wrench.
  You will find the permissible torques in chapter Thread sizes and tightening torques for fastening bolts (Page 144)

8.3 Corrective maintenance

The Siemens Service Center Bad Neustadt and other regional service sites throughout the world can handle or organize the maintenance/repair of the servo geared motors.

Consult your regional Siemens contact person if you require this service.

8.3.1 Replacing the vent valve

To ensure fault-free functioning, renew the vent valve once a year.

When replacing, prevent dirt and damaging atmospheres from entering the gearbox.

If too much oil is contained in the gearbox, oil will escape from the vent valve.
Correct the oil quantity and replace the vent valve.

8.3.2 Replacing an encoder

8.3.2.1 Replaceable encoders

In the case of the 1FG1 geared motor, a defective encoder module can be replaced with an encoder of the same type without special tools and without re-adjusting the encoder.

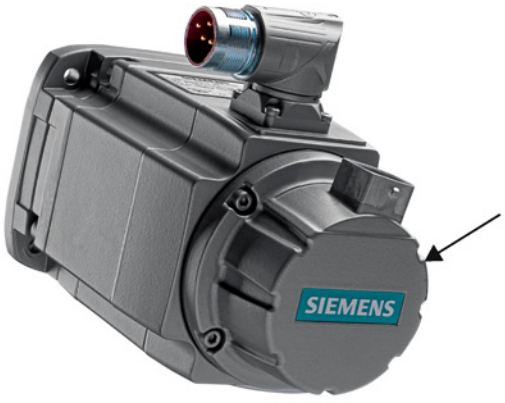
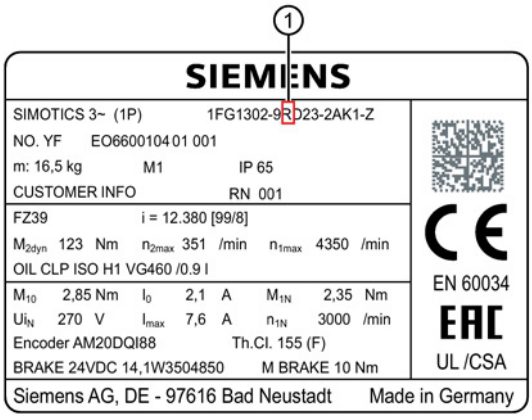


Image 8-11 Encoder side

The 9th digit of the article number on the rating plate of the geared motor describes the encoder used.



1 9th position of the MLFB

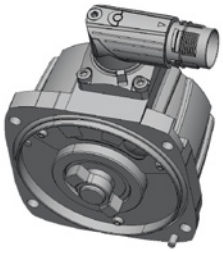
Image 8-12 Rating plate

Note

The purely mechanical replacement of the encoder is described in the section How to replace an encoder mechanically (Page 175)

Encoder module types

The following encoders can be replaced.

Motor article numbers	**1FG1□□□-□A□□□-□□□□** **1FG1□□□-□E□□□-□□□□**	**1FG1□□□-□Q□□□-□□□□** **1FG1□□□-□R□□□-□□□□**	**1FG1□□□-□Q□□□-□□□□** **1FG1□□□-□R□□□-□□□□** **Z option N16**
Encoders on 1FG1 geared motors			
Brief description	Encoders without DRIVE-CLiQ interface Analog components without motor and encoder data (electronic rating plate)	Encoders with integrated DRIVE-CLiQ interface	

Note

Integrated resolvers

You cannot replace resolvers individually. A motor with an integrated resolver has the letters "P", "S", "T" or "U" at the 14th digit of the article number.

- You must either replace the complete motor or have the motor and resolver repaired.

Encoder modules with a DRIVE-CLiQ interface have an electronic rating plate showing the settings of the associated motor as well as the encoder data.

There are several possible ways to select a replacement encoder.

- Order a replacement encoder with a custom-programmed electronic rating plate from your Siemens Service Center. In this case, you only need to replace the encoder mechanically in order to start up the system again.
- If optimal availability of your system is vital, you can stock non-preprogrammed encoders as spare parts as a precautionary measure. If a fault occurs, you can then replace the encoder and start up your system again without delay.

  With newer SINAMICS / SINUMERIK SW versions (Version 4.3 or higher), a motor can be temporarily operated without an electronic rating plate after replacing the encoder. A warning appears as long as the electronic rating plate is not yet programmed. You only need to replace the encoder mechanically in order to start up the system again.
- For older SINAMICS/SINUMERIK versions (software version prior to version 4.3), the electronic rating plate must be programmed in order to operate the motor.

8.3.2.2 Encoder replacement options

Note

Always replace the encoder as a complete component.

Replacement options for	Analog encoders without an electronic rating plate	Encoders with an electronic rating plate	
Programming options	Encoder is not pre-programmed	Encoder was preprogrammed at the factory based on the motor's electronic rating plate	
		Yes	No
Replacement option	Option 1		Option 2

Short handling instructions for each replacement option

Replacement option	Option 1	Option 2
Short handling instructions	How to replace an encoder mechanically (Page 175)	How to replace an non-preprogrammed encoder (Page 177)
Result	System ready *)	System ready *)
Other activities		Program the encoder later (How to program the encoder / import the electronic rating plate (Page 179))

*) With absolute encoders, the encoder position information must be adjusted to the machine's mechanical system (absolute adjustment)

**) The warning "No motor data stored in the encoder" will continue to appear until the electronic rating plate has been programmed.

8.3.2.3 How to select a replacement encoder

Note

Please note when ordering:

All encoders with a DRIVE-CLiQ interface have an electronic rating plate that is custom-programmed for each motor.

How to identify the article number of the encoder

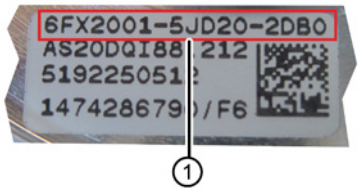
There are two possible ways of identifying the article number of the suitable encoder module.

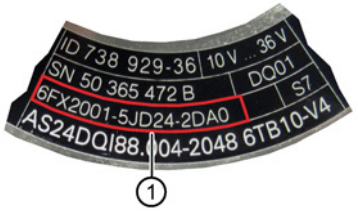
1 Read off the article number of the encoder on the rating plate (on the inside of the faulty encoder).

The rating plate is located inside of the defective encoder.

1 Encoder rating plate

There are different versions of the rating plate depending on the manufacturer and the encoder type.



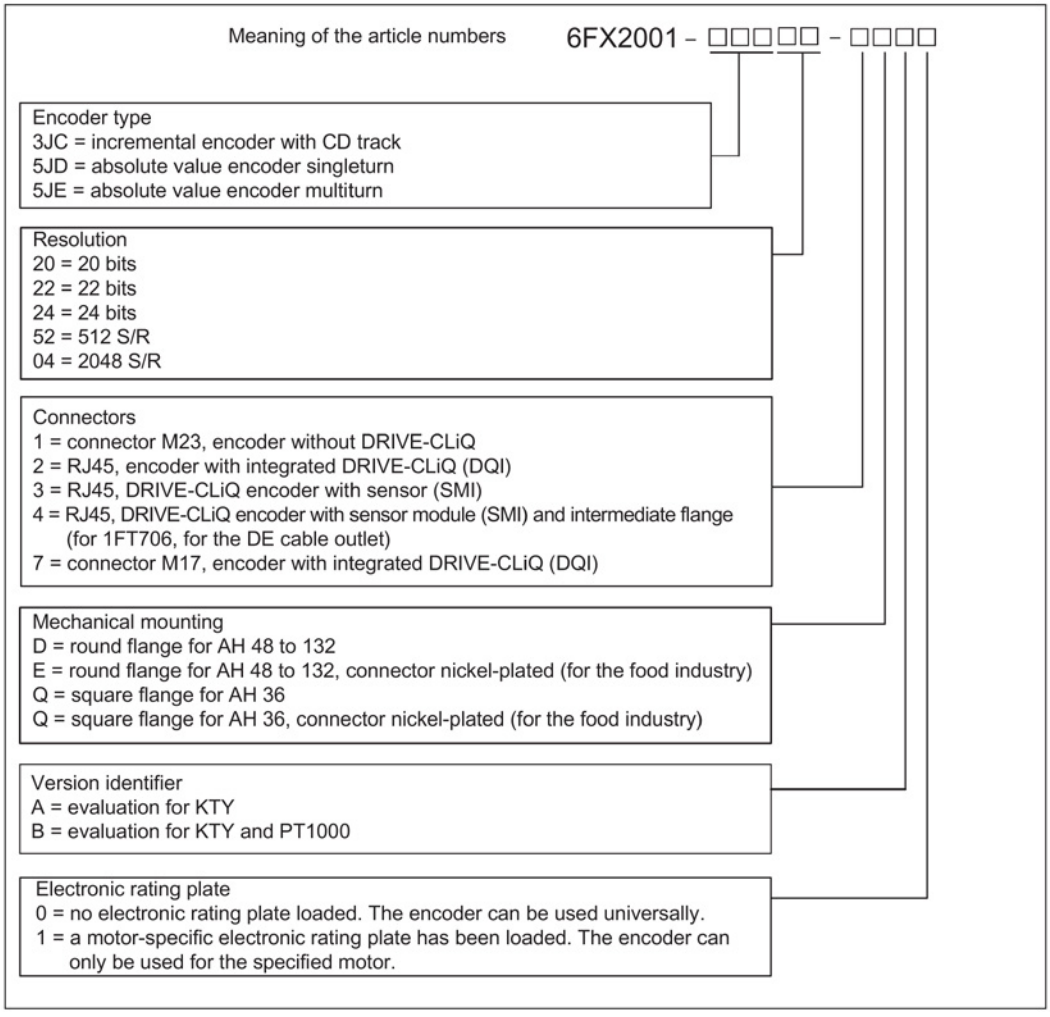


1 Encoder article number

The associated article number is located in the field with a red border.

The article number describes the deployed encoder.

The coding of the article number allows you to identify the deployed encoder.



Note

Note concerning the article number of the encoder variant that can be ordered

The article number of the encoder always ends in "0". All described encoders have a sticker with the motor article number and the serial number.

To order a non-programmed encoder (without an electronic rating plate), set the last digit of the encoder article number to "0".

To order an encoder that is preprogrammed for your particular motor, change the last digit of the encoder article number to "1".

Note

Note regarding compatibility based on version identification

A defective encoder with an "A" at the 15th position of the order number (6FX2001-5J□□□-□□**A**□) can also be replaced with a replacement encoder with a "B" at the 15th position of the order number (6FX2001-5J□□□-□□**B**□).

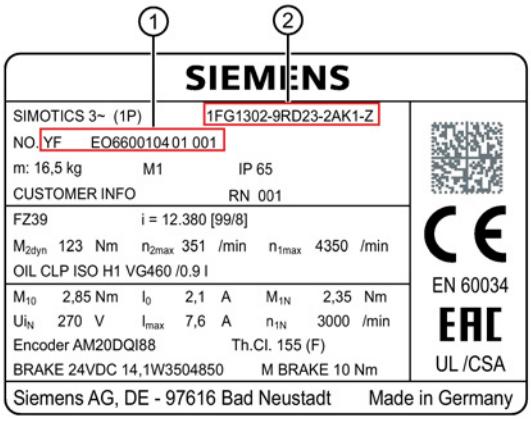
A defective encoder with a "B" at the 15th position of the order number (6FX2001-5J□□□-□□**B**□) cannot be replaced with a replacement encoder with an "A" at the 15th position of the order number (6FX2001-5J□□□-□□**A**□).

Dismantle the encoder by following the procedure described in Chapter "How to replace an encoder mechanically (Page 175)"

→ After reading off the encoder article number, you can then order a new encoder direct.

2 Specify the order number for the motor type (article number) and the motor serial number online on "Spares on Web".

You can find both of these numbers on the rating plate of the motor.



1 Serial number of the motor

2 Order number for the motor type (article number)

Specify the article number and the serial number of the motor online at "Spares on Web (https://www.siemens.com/sow)".

→ The encoder you are looking for then appears in a result list on the "Spare part packages" tab.

Note

The displayed order number (article number) of the encoder always ends in "1".

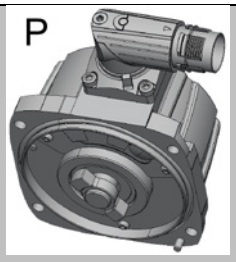
To order an encoder that is preprogrammed for your particular motor, leave the last digit of the encoder article number set to "1".

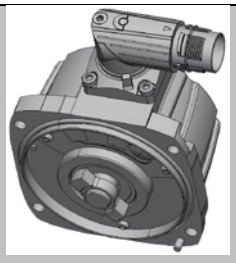
To order a non-preprogrammed encoder (without an electronic rating plate), change the last digit of the encoder article number to "0".

3 Identify the order number using the tables below

Programmed encoder with integrated DRIVE-CLiQ interface (DQI)			
Encoder type	**For motor**	**Designation**	**Order number**
Encoder type	**For motor**	**Designation**	**Order number**
Absolute encoder, singleturn, 20-bit **1FG1□□□-□Q□□□-□□□**	1FG1□□□-□□C	AS20DQI-72	6FX2001-5JD20-2QA1
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AS20DQI-88	6FX2001-5JD20-2DA1
Absolute encoder 20-bit + 12-bit multiturn **1FG1□□□-□R□□□-□□□**	1FG1□□□-□□C	AM20DQI-72	6FX2001-5JE20-2QA1
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AM20DQI-88	6FX2001-5JE20-2DA1

Non-programmed encoder with integrated DRIVE-CLiQ interface (DQI)			
Encoder type	**For motor**	**Designation**	**Order number**
Absolute encoder, singleturn, 20-bit **1FG1□□□-□Q□□□-□□□**	1FG1□□□-□□C	AS20DQI-72	6FX2001-5JD20-2QA0
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AS20DQI-88	6FX2001-5JD20-2DA0
Absolute encoder 20-bit + 12-bit multiturn **1FG1□□□-□R□□□-□□□**	1FG1□□□-□□C	AM20DQI-72	6FX2001-5JE20-2QA0
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AM20DQI-88	6FX2001-5JE20-2DA0

Programmed encoders with an integrated DRIVE-CLiQ interface (DQI) and M17 round connector			
Encoder type, replaceable	**For motor**	**Designation**	**Order number**
Absolute encoder, singleturn, 24-bit **1FG1□□□-□Q□□□-□□□□** **With Z option: N16**	1FG1□□□-□□C	AS24DQI-72	6FX2001-5JD24-7RB1
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AS24DQI-88	6FX2001-5JD24-7EB1
Absolute encoder 24-bit + 12-bit multiturn **1FFG1□□□-□R□□□-□□□□** **With Z option: N16**	1FG1□□□-□□C	AM24DQI-72	6FX2001-5JE24-7RB1
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AM24DQI-88	6FX2001-5JE24-7EB1

Non-programmed encoders with an integrated DRIVE-CLiQ interface (DQI) and M17 round connector			
Encoder type, replaceable	**For motor**	**Designation**	**Order number**
Absolute encoder, singleturn, 24-bit **1FG1□□□-□Q□□□-□□□□** **With Z option: N16**	1FG1□□□-□□C	AS24DQI-72	6FX2001-5JD24-7RB0
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AS24DQI-88	6FX2001-5JD24-7EB0
Absolute encoder 24-bit + 12-bit multiturn **1FG1□□□-□R□□□-□□□□** **With Z option: N16**	1FG1□□□-□□C	AM24DQI-72	6FX2001-5JE24-7RB0
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AM24DQI-88	6FX2001-5JE24-7EB0

Encoder without DRIVE-CLiQ interface (M23 signal connector)			
Encoder type	**For motor**	**Designation**	**Order number**
Incremental encoder sin/cos 1 Vpp 2048 S/R **1FG1□□□-□A□□□-□□□**	1FG1□□□-□□C	IC2048S/R-72	6FX2001-3JC04-1QA0
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	IC2048S/R-88	6FX2001-3JC04-1DA0
Absolute encoder 2048 S/R EnDat **1FG1□□□-□E□□□-□□□**	1FG1□□□-□□C	AM2048S/R-72	6FX2001-5JE04-1QA0
	1FG1□□□-□□D 1FG1□□□-□□E 1FG1□□□-□□F 1FG1□□□-□□G	AM2048S/R-88	6FX2001-5JE04-1DA0

After selecting the correct encoder, place your order as described in chapter "Ordering encoders (Page 175)".

8.3.2.4 How to order encoders

Note

Please note when ordering:

All encoders with a DRIVE-CLiQ interface have an electronic rating plate that must be custom-programmed for each motor.

Order of a programmed or non-programmed encoder?

Non-programmed encoders	Programmed encoders
Encoder is suitable for several motor series.	Encoder is only designed for one motor (determined by the article number and the serial number).
Encoders with a DRIVE-CLiQ interface must be programmed subsequently.	Motor is fully functional as soon as the encoder is mounted.
Encoders are painted "pearl dark gray" as standard.	
Select the last digit of order number always as "0".	Select the last digit of order number always as "1".

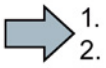
How to order

Make a note of the following numbers before you order a replacement encoder:

- The order number of the replacement encoder (refer to Chapter "How to select a replacement encoder (Page 167)")
- The article number of the motor (refer to the rating plate on the motor)
- The serial number of the motor (refer to the rating plate on the motor)

You can order replacement encoders through your Siemens contact.

Information for the person placing the order:



1. Go to the appropriate ordering page in SAP.
2. Enter the article number and serial number of the motor in the COI3 field.

If you have any questions, please contact Technical Support.

The encoder has now been ordered.

8.3.2.5 How to replace an encoder mechanically

Procedure

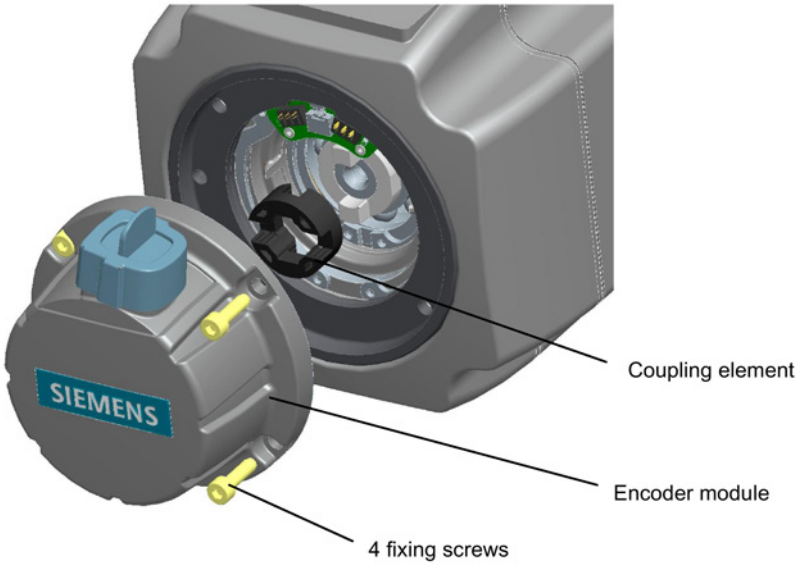
Note

If you need to replace several encoders, you should always do so one at a time. This will avoid confusion and rule out programming errors.

1.
2.

1 To remove

1. Disconnect the motor.
2. Disconnect the encoder cable.



3. Remove the four fastening screws for the encoder.
4. Remove the encoder and the coupling element.

Note

Coupling element

When replacing the encoder, the new coupling element enclosed with it must be installed at the same time.

2 To install

1. Attach the coupling element to the coupling hub of the encoder shaft.

Image 8-13 Encoder side details

2. Align the coupling element with the cams on the motor shaft.
3. Attach the encoder to the motor shaft in this position.
4. Secure the encoder with four screws (tightening torque: 2.5 to 3 Nm).
5. Plug the encoder cable into the receptacle on the encoder.

⚠ WARNING

Danger of death if the encoder is not properly installed or the safety devices do not work

If the encoder or any other parts of the machine are not properly installed or any safety devices do not work, this could result in death or injury to persons.

- Make sure all parts of the machine are correctly installed and connected.
- Make sure all safety devices are switched on again and working correctly.

Switch on the system.

3 Absolute adjustment

Note

Only absolute encoders need to be adjusted.

When you adjust an absolute encoder, its actual value is compared once with the machine zero point and then set to valid.

The actual adjustment status of an absolute encoder is shown in the following machine data:

SINUMERIK	SINAMICS
MD34210 §MA_ENC_REFP_STATE (absolute encoder status)	p2507 (absolute adjustment status)

- Adjust the encoder as described in the Function Manual

The motor is now ready for operation again.

8.3.2.6 How to replace an non-preprogrammed encoder

Requirements

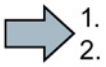
NOTICE
Wrong encoder installed If you install an encoder of the wrong type or one that was preprogrammed for another motor, malfunctions are likely to occur. • Always replace a faulty encoder with another encoder of the same type. Never attempt to retrofit a motor with a different encoder type.

- The replacement encoder must not be of the same type as the faulty encoder.
- The encoder must not be preprogrammed. Either it has not yet been used in another motor or the program was completely deleted.

Note

If you need to replace several encoders, you should always do so one at a time. This will avoid confusion and rule out programming errors.

Encoder replacement procedure



1 Save the data on the electronic rating plate

The encoder data is automatically saved when you start up the system. You do not need to save it manually.

2 Replace the encoder mechanically

To replace the encoder mechanically, refer to section "How to replace an encoder mechanically (Page 175)".

3 Program the encoder

Note

The motor data (electronic rating plate) must be installed later on a non-preprogrammed encoder with a DRIVE-CLiQ interface. The motor control shows warning "1840" as long as this is not the case.

If the motor data is not installed, it will no longer be available when the motor is started up again or if it is used in another application.

- Program the encoder as described in section "How to program the encoder / import the electronic rating plate (Page 179)".

4 Absolute adjustment

Note

Only absolute encoders need to be adjusted.

When you adjust an absolute encoder, its actual value is compared once with the machine zero point and then set to valid.

The actual adjustment status of an absolute encoder is shown in the following machine data:

SINUMERIK	SINAMICS
MD34210 §MA_ENC_REFP_STATE (absolute encoder status)	p2507 (absolute adjustment status)

- Adjust the encoder as described in the Function Manual

The encoder has now been replaced.

8.3.2.7 How to program the encoder / import the electronic rating plate

When you program the encoder, the data on the electronic rating plate is transferred to it.

Note

Before importing the data from the electronic rating plate, replace the faulty encoder with a non-preprogrammed encoder of the same type.

Requirements for writing the data on the encoder module

- SINAMICS firmware Version 2.5 or higher must be installed.
  SINUMERIK firmware Version 2.5 SP2 HF1 or higher (essential for replaceable encoders) must be installed.
- The commissioning procedure must have been completed.
- The electronic rating plate must be installed on the CF card.

  Note

  With SINAMICS / SINUMERIK SW Version 4.3 or higher the data on the electronic rating plate is automatically saved in the folder provided for this purpose on the CF card (refer to section "How to save the data on the electronic rating plate. (Page 183)").

  If the data has not been saved on the CF card, there are two possible ways to obtain it:
  - If the component to be replaced can still be accessed via the DRIVE-CLiQ interface, you can read out the data on the electronic rating plate and then save it (refer to section "How to save the data on the electronic rating plate. (Page 183)").
  - If this no longer works, you can download the data for the electronic rating plate from the motor plant on the Internet. Consult your Siemens representative (http://www.siemens.com/industry/contact) if you require this service

- A non-preprogrammed encoder module of the same type must be available.

  Note

  If you need to replace several encoders, you should always do so one at a time to avoid confusion and rule out programming errors.

To start the import

You start the data import by setting drive parameters.

Note

Automatic import in SINUMERIK

SINUMERIK Operate versions (>V4.6) have a menu that lets you import the encoder data into a non-preprogrammed encoder.

If this function is available, you can find it under: Commissioning>Drive System>Hardware Replacement

SINUMERIK systems	SINAMICS systems
Drive parameters can be set directly on the machine's HMI.	Drive parameters can only be set using a commissioning or diagnostic tool (e.g. STARTER or SCOUT).
Requirement: The manufacturer password must be used. The default setting is "SUNRISE".	Requirement: CUSTOMER access level

Options for starting the import

To import the data

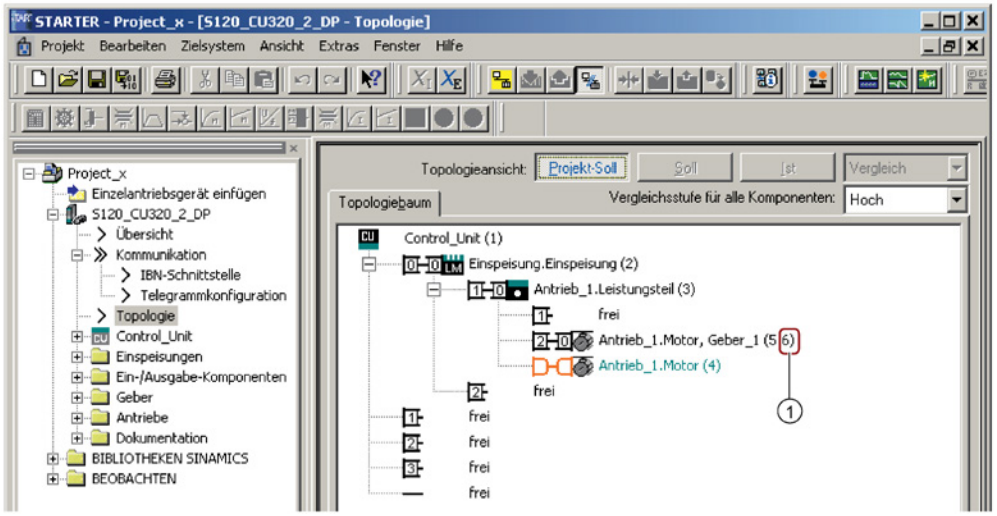
Switch on the machine.

→ After the drive / control has started up, you see warning "1840 – Found component with no motor data".

To identify the component number in SINAMICS using the STARTER software

There are two possible ways to identify the component number.

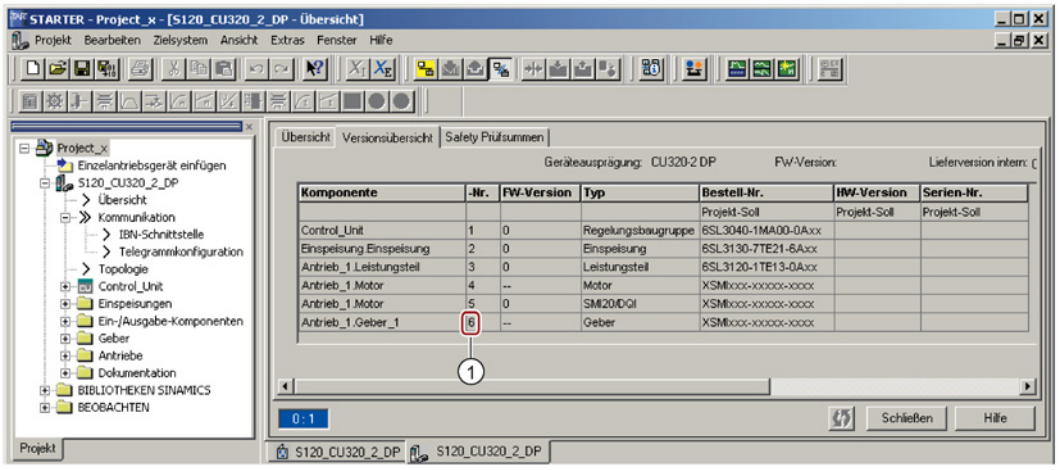
- Identify the component number in the topology tree.



1 Component number of the encoder module

Image 8-14 STARTER topology view

- Identify the component number in the version overview

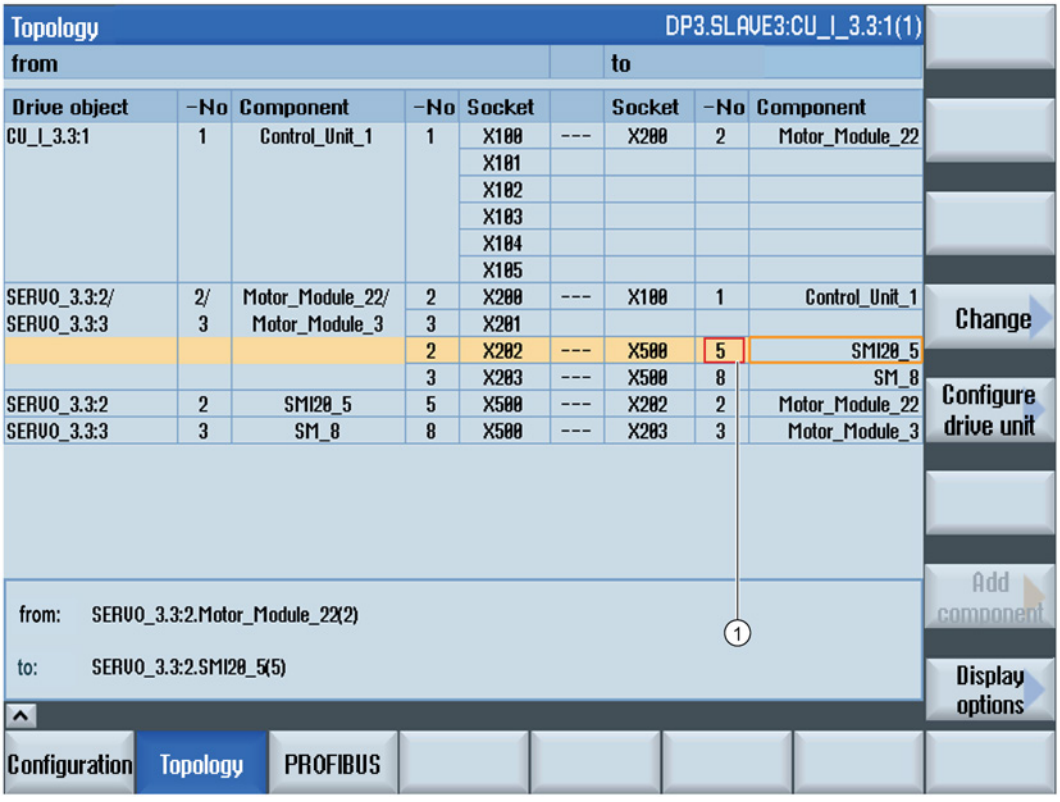


1 Component number of the encoder module

Image 8-15 STARTER versions view

To identify the component number in SINUMERIK

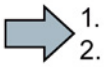
Open the topology tree.



1 Component number of the encoder module

Image 8-16 SINUMERIK topology view

To transfer the data to the encoder module



1. Enter the sensor module component number in the p4690 parameter for which the data on the electronic rating plate must be written.
2. To begin writing, set the p4691 parameter to "2".

   → The data stored at the transfer point is written in the module (refer to section "How to save the data on the electronic rating plate. (Page 183)").

   → If this operation is successful, the value of the p4691 parameter changes back to "9" ("SMI data imported and POWER ON required for component").

   → If the p4691 parameter changes to a value other than "9", this number will help you identify why the write operation failed.

   Note

   You can find the meanings of the parameter values in List Manual 1 as well as in the online help.

3. Restart the system. (POWER OFF--> POWER ON)
4. If the encoder is an absolute encoder, you must readjust it. Adjust the encoder as described in the Function Manual.

The data has now been transferred to the encoder module.

8.3.2.8 How to save the data on the electronic rating plate.

How to save the electronic rating plate for a motor

The data on the electronic rating plate is saved on the system card (CF card). The electronic rating plate is required to program a non-preprogrammed encoder module.

Requirements for saving the data on the electronic rating plate

- SINAMICS firmware Version 2.5 or higher must be installed.
- The commissioning procedure must have been completed. All component numbers must be less than 200.

To save the data

Note

With SINAMICS / SINUMERIK SW Version 4.3 or higher the data is automatically saved when you start up the system. You do not need to save it manually.

WARNING

Danger of death if the encoder is not properly installed or the safety devices do not work

If the encoder or any other parts of the machine are not properly installed or any safety devices do not work, this could result in death or injury to persons.

- Make sure all parts of the machine are correctly installed and connected.
- Make sure all safety devices are switched on again and working correctly.

1. Switch on the machine.
2. Identify the component number of the encoder module to be saved in the topology tree.
3. Enter the component number in the p4690 parameter of the encoder module for which the data on the electronic rating plate must be saved on the system card.
4. To begun saving, set the p4691 parameter to "1".

→ If the operation is successful, the value of the p4691 parameter changes back to "0".

→ If the p4691 parameter changes to a value other than "0", this number will help you identify why the write operation failed.

Note

You can find the meanings of the parameter values in List Manual 1 as well as in the online help.

The data on the electronic rating plate is automatically saved in the correct path on the system card (CF card).

The data on the electronic rating plate has now been saved on the CF card.

How to save the electronic rating plates for all motors

If you wish, you can also save the rating plates for all motors at once.

1
2

- To begin saving, set the p4692 parameter to "1".

→ If the operation is successful, the value of the p4692 parameter changes back to "0".

The data has now been saved in a defined path on the system card (CF card).

8.3.2.9 Diagnostics

The SINAMICS firmware contains monitoring and diagnostic functions for DRIVE-CLiQ modules and DRIVE-CLiQ encoders.

In the event of a fault, the corresponding alarm and fault messages are generated and communicated to the user. The diagnostic tools (e.g. Starter, Scout etc.) or a higher-level control are normally used for this purpose.

Decommissioning and disposal 9

9.1 Safety instructions

Removing the motor from the machine

⚠ WARNING

Danger to life when live parts are touched

Death or serious injury can result when live parts are touched.

- Only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.

Generally, six steps apply when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the power supply.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that it really de-energized, from phase to phase and phase to protective conductor.
   - Check that every auxiliary circuit is de-energized.
   - Ensure that the motors cannot move.
3. Secure SIMOTICS S motors against unintentional movements that generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources, for example by closing switches, grounding or short-circuiting, or closing valves.
6. Take measures to prevent reconnection of the energy sources.
7. Make sure that the machine is completely locked ... and that you have the right machine.

After you have completed the work, restore operational readiness by performing the above steps in the reverse order.

⚠ WARNING

Danger to life due to slipping on leaked oil

Leaked oil can result in slipping or falling and cause death or severe injury.

- Prevent oil from leaking
- Absorb leaked oil immediately with a binding agent for oil or similar.
- Rough up the hazardous location.
- Mark the hazardous location.

⚠ CAUTION

Burning hazard caused by hot surfaces

Some parts of the frame of electrical machines can reach temperatures in excess of 100° C. Touching components when the machine is in operation can cause burns.

- Do not touch frame parts while the machine is in operation or immediately after machine operation.
- Allow frame parts to cool off before starting any work.

⚠ CAUTION

Danger of scalding from the hot oil exiting the unit

Exiting hot oil can cause burns.

- Before starting any work, wait until the oil has cooled down to below 30° C.

⚠ CAUTION

Chemical burns and irritations caused by chemical cleaning agents

Chemical cleaning agents can be caustic or emit dangerous fumes. If these come into contact with skin or if you inhale the fumes, this can cause injuries, e.g. chemical burns on the skin or respiratory passages, or skin irritation.

- During cleaning, make sure that appropriate methods of extracting fumes are in place and that you wear the appropriate protective gear (e.g. gloves, goggles, face masks).
- If using chemical cleaning agents, observe the instructions and any warnings provided in the relevant safety data sheet. Chemical cleaning agents must be suitable for use with the machine's components, particularly where plastic components are concerned.

⚠ WARNING

Danger to life caused by falling machine parts

The machine partially comprises heavy individual components. When removing the machine, these components can fall. This can result in death, serious injury or material damage.

- Secure the machine components that are being released so that they cannot fall.

⚠ WARNING

Injury as a result of suspended loads

When being dismantled and transported, the motor can cause injury as a result of its movement.

- Only use perfectly functioning hoisting and load suspension equipment dimensioned to carry the motor load.
- Pay careful attention to possible movement when the motor is released.
- Do not stand under suspended loads or in their slewing range.
- When placing down the motor, ensure that it cannot roll.

⚠ CAUTION

Injuries caused by liquids when draining and environmental pollution

When draining, liquids can cause injuries, such as burns, chemical burns, irritation. Spilt oil can make floor surfaces slippery and pollute the environment.

- Allow the liquid to cool down.
- Use a sufficiently large collection container.
- Avoid liquids coming into contact with the skin. Wear suitable personnel protection equipment, e.g. protective eyewear, gloves.
- Have materials on hand to soak up leaked liquids and prevent areas from being slippery.

Dismantling the motor

Note

The rotor in a motor containing permanent magnets must only be removed by the manufacturer.

- Contact the Siemens Service Center (https://support.industry.siemens.com/cs/?lc=de-WW).

9.2 Decommissioning

9.2.1 Preparing for dismantling

The dismantling of the geared motor must be performed and/or supervised by qualified personnel with appropriate expert knowledge.

Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality of disassembling the geared motor and provision of the components.

Removing the geared motor from the machine

Procedure

1. Disconnect all electrical connections.
2. Remove all liquids such as oil.
3. Remove all supply lines.
4. Remove the fixing elements from the geared motor.
5. Transport the geared motor to a suitable location for storage and dismantling.

You have removed the motor.

9.2.2 Dismantling the motor

Note

The rotor in a motor containing permanent magnets must only be removed by the manufacturer.

Contact the Siemens Service Center (https://support.industry.siemens.com/cs/?lc=de-WW).

9.3 Disposal

Protecting the environment and preserving its resources are corporate goals of the highest priority for us. Our worldwide environmental management system according to ISO 14001 ensures compliance with legislation and sets high standards in this regard. Environmentally friendly design, technical safety and health protection are always firm goals even at the product development stage.

Recommendations for the environmentally friendly disposal of the machine and its components are given in the following section. Be sure to comply with local disposal regulations.

Empty the used oil from the gearbox into a sufficiently large container.

Bind the escaped oil with a sorbent. Dispose of the sorbent in accordance with the applicable legal regulations.

Separate the housing parts, gear wheels, shafts and roller bearings of the geared motor according to their material. Dispose of the parts in accordance with the applicable legal regulations.

Dispose of the packaging material in accordance with the applicable legal regulations.

Components

- Sort the components for recycling according to whether they are:
  - Electronics waste, e.g. encoder electronics
  - Iron to be recycled
  - Aluminum
  - Non-ferrous metal, e.g. motor windings
  - Insulating materials

Process materials and chemicals

- Sort the process materials and chemicals for recycling according to whether they are:
  - Oil
  - Dispose of the spent oil as special waste in accordance with the spent oil ordinance
  - Grease
  - Solvents
  - Cleaner solvent
  - Paint residues
- Do not mix solvents, cleaner solvents and paint residues.

Table 9- 1 Disposal codes for gear oils

Oil types	Designation	Disposal code
Mineral oil	CLP ISO VG220	13 02 05
Polyglycols	CLP ISO PG VG220, CLP ISO PG VG460	13 02 08
Poly-Alpha-Olefins	CLP ISO PAO VG68, CLP ISO PAO VG220, CLP ISO H1 VG100, CLP ISO H1 VG460	13 02 06
Biologically degradable oils	CLP ISO E VG220	13 02 07

Disposing of permanent magnets

Permanent magnets must be demagnetized prior to disposal. This helps avoid potential hazards caused by permanent magnets during and after disposal. Permanent magnets are heated to demagnetize them.

Permanent magnets can be demagnetized in one of the following ways:

- Have a specialist disposal company thermally treat the motor
- Hand over the motor to the manufacturer who can then remove and demagnetize the rotor and/or permanent magnets.

Note

Rotors that have been removed but are still magnetized cannot be transported.

Note

Removing the rotor

A magnetized rotor may only be removed by the manufacturer. Contact the Siemens Service Center (https://support.industry.siemens.com/cs/?lc=de-WW).

Appendix

A

A.1 Siemens Service Center

At

http://www.siemens.com/automation/service&support

you can find Siemens contacts worldwide for information about specific technologies.

Wherever possible, you will find a local contact partner for:

- Technical support,
- Spare parts/repairs,
- Service,
- Training,
- Sales or
- Technical support/engineering.

You start by selecting a

- Country,
- Product or
- Sector.

Once the remaining criteria have been laid down, the required contact will be shown along with the associated area of expertise.

A.2 Declaration of conformity

SIEMENS

EG-Konformitätserklärung

EC Declaration of Conformity

No. 664.20045.01

Hersteller: *Manufacturer:*	**Siemens AG** Digital Factory DF MC MF-M
Anschrift: *Address:*	Industriestraße 1 97616 Bad Neustadt a. d. Saale Germany
Produktbezeichnung: *Description of the product:*	**Servogetriebemotoren SIMOTICS S-1FG1...** ***Servo Geared Motors SIMOTICS S-1FG1...***

Die bezeichneten Produkte stimmen in der von uns in Verkehr gebrachten Ausführung mit den Vorschriften folgender Europäischer Richtlinie überein:
The products described above in the form as delivered are in conformity with the provisions of the following European Directive:

2006/95/EG Richtlinie des Europäischen Parlaments und des Rates vom 12. Dezember 2006 zur Angleichung der Rechtsvorschriften der Mitgliedstaaten betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen.
Directive of the European Parliament and the Council of 12. December 2006 on the approximation of the laws of the Member States related to electrical equipment designed for use within certain voltage limits.

Die Konformität mit der Richtlinie wird nachgewiesen durch die Einhaltung folgender Normen:
Conformity to the Directive is assured through the application of the following Standards:

EN 60034-1*):2010 EN 60204-1:2006 +A1:2009 +AC:2010
) mit allen relevanten Teilen / *with all relevant parts

Die Sicherheitshinweise und Betriebsanleitungen sind zu beachten.
The safety and manual documentation have to be considered in detail.

Erste CE - Kennzeichnung: 2015 */ first CE - marking: 2015*

Die bezeichneten Produkte sind zum Einbau in andere Maschinen bestimmt. Die Inbetriebnahme ist solange untersagt, bis die Konformität des Endproduktes mit der Richtlinie 2006/42/EG festgestellt ist.
Alle Sicherheitshinweise der zugehörenden Produktdokumentation sind zu beachten sowie dem Endanwender zur Kenntnis zu geben.
Diese Erklärung stellt keine Beschaffenheits- und Haltbarkeitsgarantie gemäß § 443 BGB dar.
The products supplied are intended exclusively for installation in a machine. Commissioning is prohibited until it has been established that the end product conforms with the Directive 2006/42/EC. All safety instructions in the associated product documentation must be observed and given to the end user for his/her information.
This declaration contains no condition and durability guarantee to § 443 BGB (German Civilian Code).

Bad Neustadt, den
Siemens Aktiengesellschaft

13.03.2015
Dr. Uwe Schüller,
Head of Competence Center Motors

13/3.2015
Peter Deml,
Head of Production

Diese Erklärung bescheinigt die Übereinstimmung mit der genannten Richtlinie, ist jedoch keine Zusicherung von Eigenschaften.
This declaration certifies the compliance with the indicated directives but does not imply any warranty for properties.

Ausgabestand / *Status*: 03/2015
Erstausgabe / *first document*: 2015

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For further information on SIMOTICS S please scan the QR code.

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